6 FEBRUARY 1961

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ELECTRICAL TIMES

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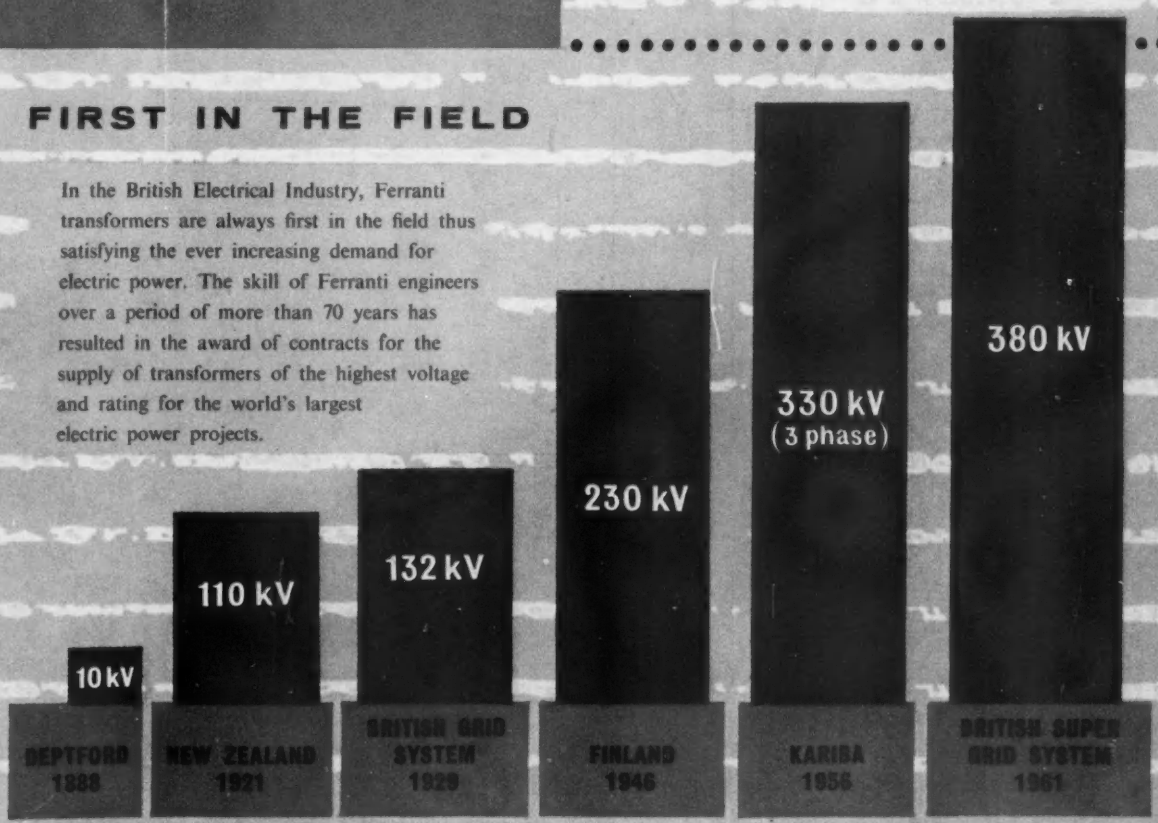

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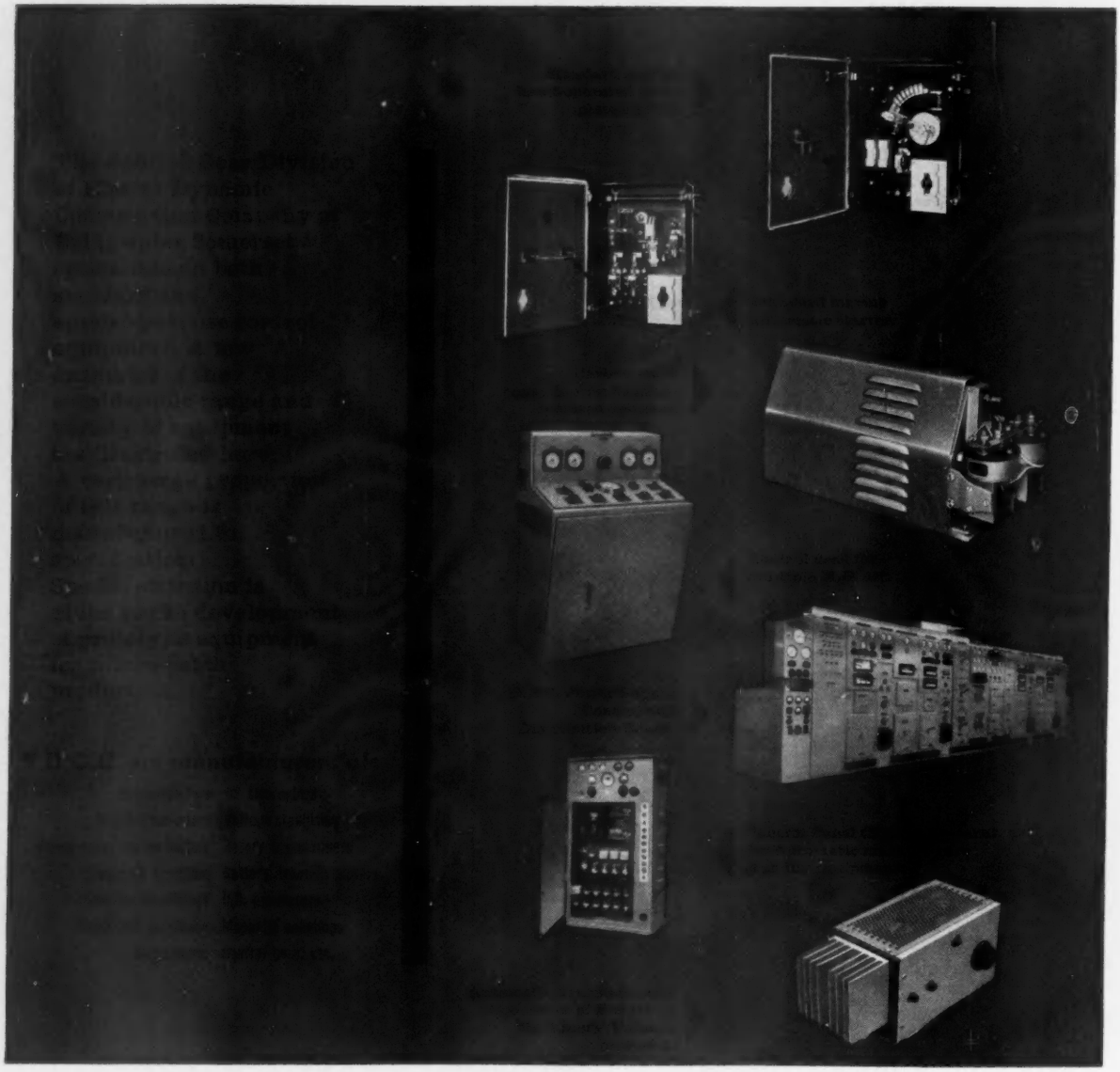

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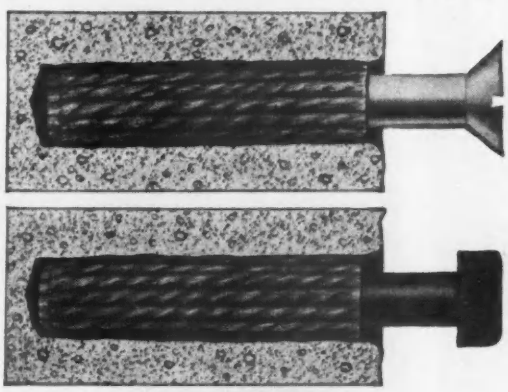

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FOR ALL SCREW SIZES

There's a Rawlplug for every size of screw up to ¾″ diameter coach screws, which take a load of 4 tons.

Rawlplugs are the fixing for *neatness* as well as speed and strength—no mess, no damage to surrounding materials, almost invisible in position. Being rotproofed and waterproofed during manufacture, they can be used under all climatic conditions. Screws can be withdrawn and replaced without affecting the efficiency of the Rawlplugs.

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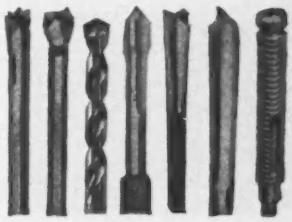


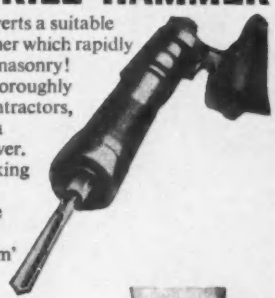
R.P.2 *Two-speed* ELECTRIC DRILL

Keyless Chuck

At the touch of a button you can change the speed of this drill from 1200 r.p.m. to 420 r.p.m. which is the ideal speed for Durium Masonry Drills. Chuck capacity is 5/16″. Finger tightening holds the smallest drill in rigid grip which increases with the load yet can be easily released.

RAWLPLUG DRILL HAMMER

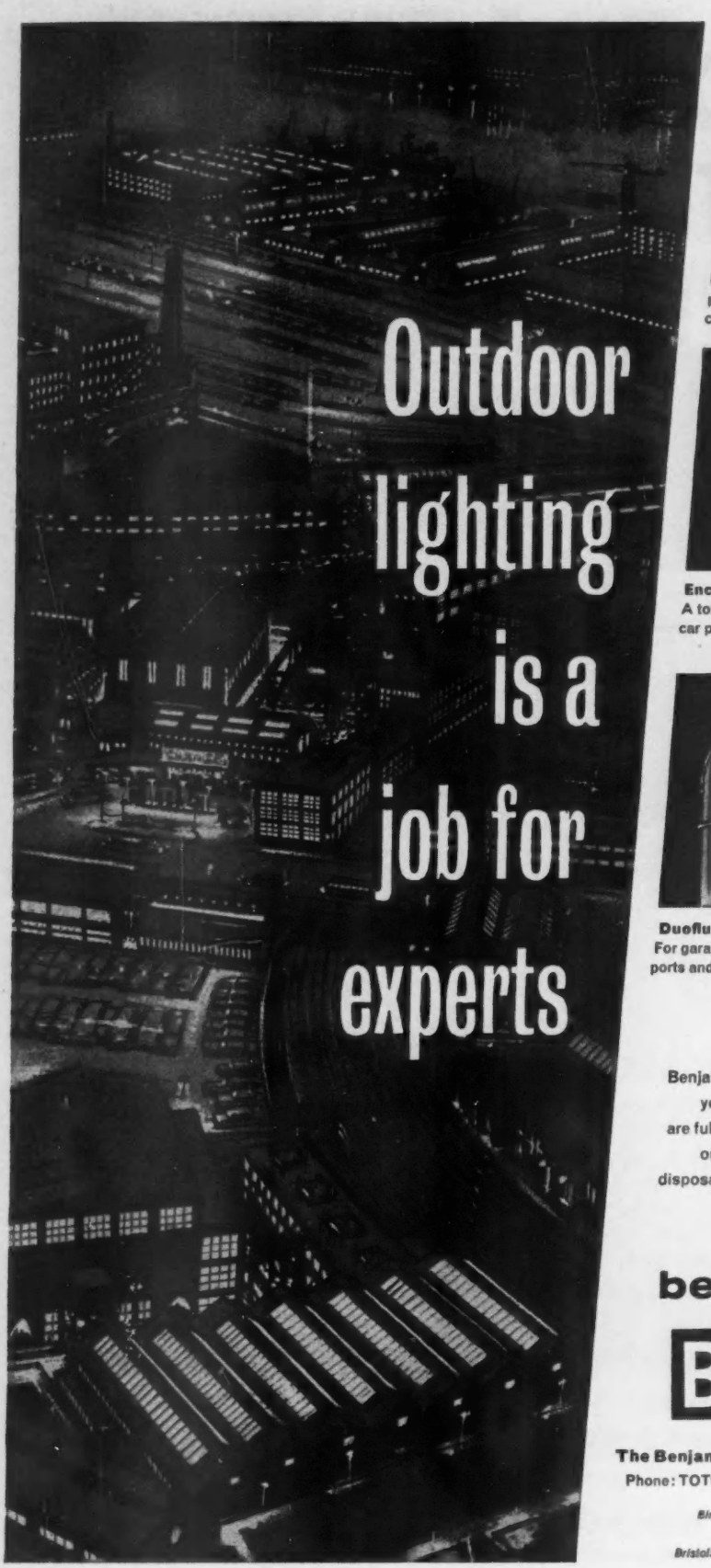
This ingenious attachment converts a suitable electric drill into a Power Hammer which rapidly bores holes in even the hardest masonry! A sturdy high-precision tool, thoroughly proved and used by famous Contractors, the Rawlplug Drill Hammer is a magnificent time-and-money saver. Suits any electric drill with working speed up to 2000 r.p.m. and minimum ¼″ chuck. Speed—one blow per chuck rev. Weight of blows adjustable 'light', 'medium' and 'heavy'.



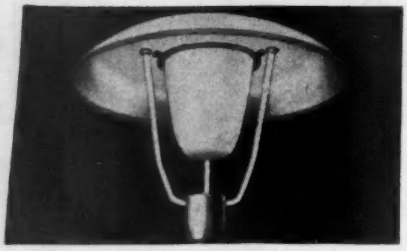
Rawlplug VIBROTO Drilling Machine

The performance of this sensational 3 in 1 power tool must be seen to be believed—three high-precision machines in one! The Vibroto R.V.1 machine provides (1) dual vibration action (with Vibroto Drills, faster masonry drilling even than Durium!); (2) Rotary action for standard Durium Drills; (3) general purpose tool for use with standard twist drills. Vibration frequencies 7,500 and 11,200 per minute. Weight 9 lb. Length overall 18¼″. Fully guaranteed. The R.V.2 machine is a smaller version and although lighter in weight it has all the advantages of the R.V.1 for drilling holes in masonry up to No. 14 using Vibroto hard-tipped drills.

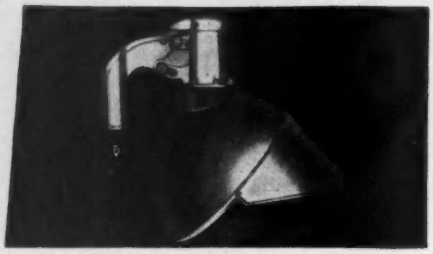
RAWLPLUGS



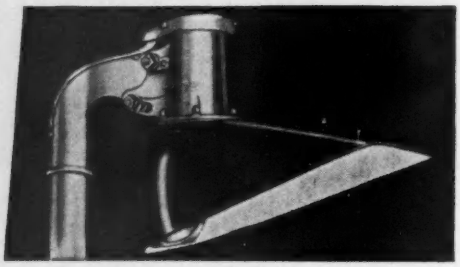
Outdoor lighting is a job for experts



Mushroom Fitting
For public gardens, forecourts for public buildings, schools, promenades, shopping centres, service stations etc.



Enclosed Area Floodlight
A totally enclosed fitting designed for car parks, garages, forecourts etc.



Duoflux Floodlight
For garages and service stations, sports stadia, ports and dockyards, marshalling yards, etc.

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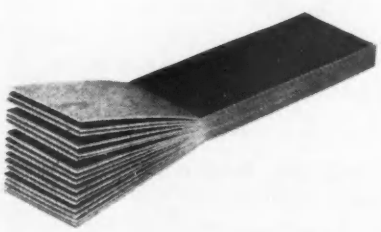

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The Illustration shows Automatic Star-Delta Starter with built-on isolator and flush mounting push button station with selector switch.

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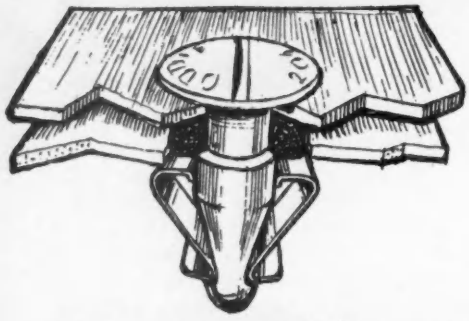

The FASTENER with ENDLESS APPLICATIONS
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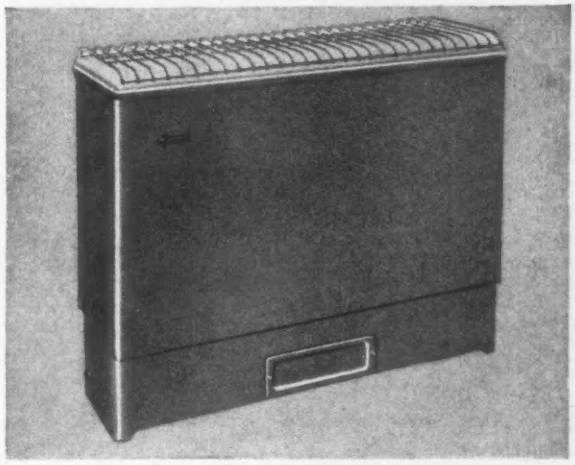
presenting the 3kW Nightstor heater...



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. . . to meet the demand of larger 'off-peak' installations

This handsome new model adds flexibility to the Nightstor family. Its higher loading and competitive price will reduce installation costs and, like all Nightstors it is cheap to run too, using electricity at low 'off-peak' rates by storing heat at night for use the following day. It fits flush to the wall using as little space as possible and, of course, this automatic form of heating does away with the need for boiler room, fuel store, flues and chimneys. In addition there are no maintenance worries and positively no smoke!

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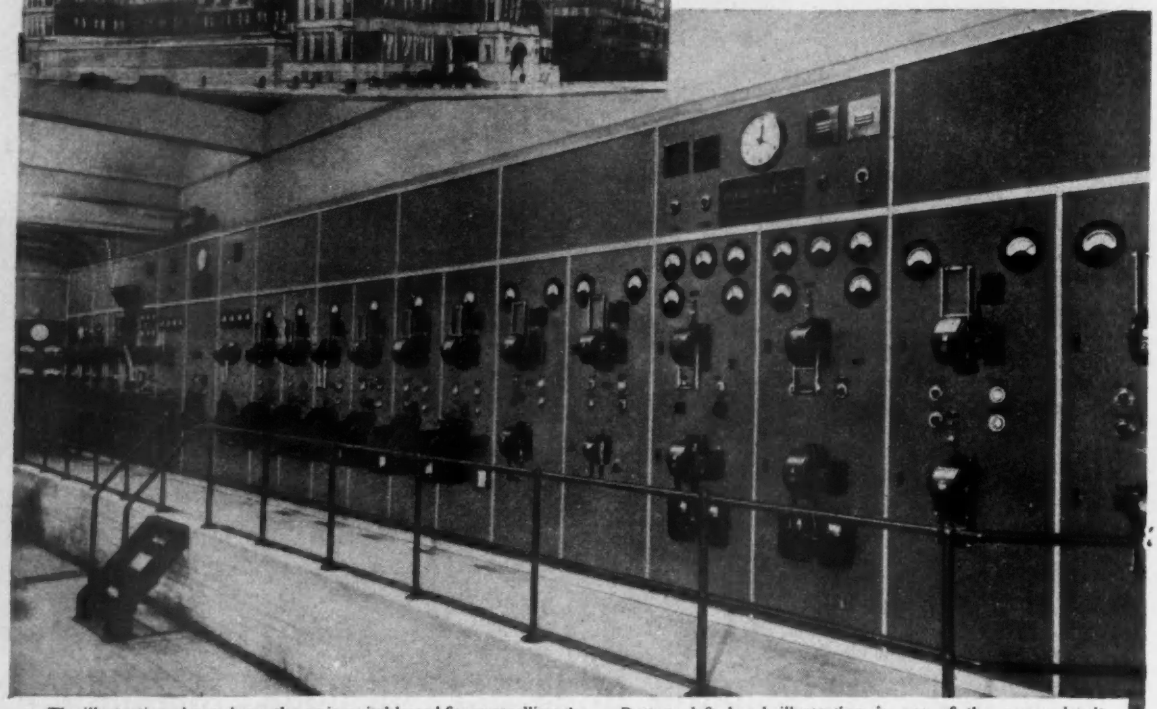
THE COLLEGE OF SCIENCE AND TECHNOLOGY, MANCHESTER

have installed

"ERSKINE HEAP" SWITCHGEAR & MOTOR CONTROL GEAR

The Architects for the building were Bradshaw, Gass and Hope of Bolton, who were also responsible for the design of the engineering services.



The illustration above shows the main switchboard for controlling the power and lighting to both the original College and the New Extensions. The switches are of 25 MVA rupturing capacity, tested to BS.116 at 400 volts. Duplicate bus bars are provided with front-of-board operated changeover switches for changing over between the College's own Turbo Alternator Set and the Electricity Board.

Bottom left hand illustration is one of the many circuit breakers for controlling the lift installations.
The centre illustration below shows a few of the twelve distribution boards throughout the building.
The bottom right hand illustration shows one of the solenoid operated 25 MVA ironclad circuit breaker units.

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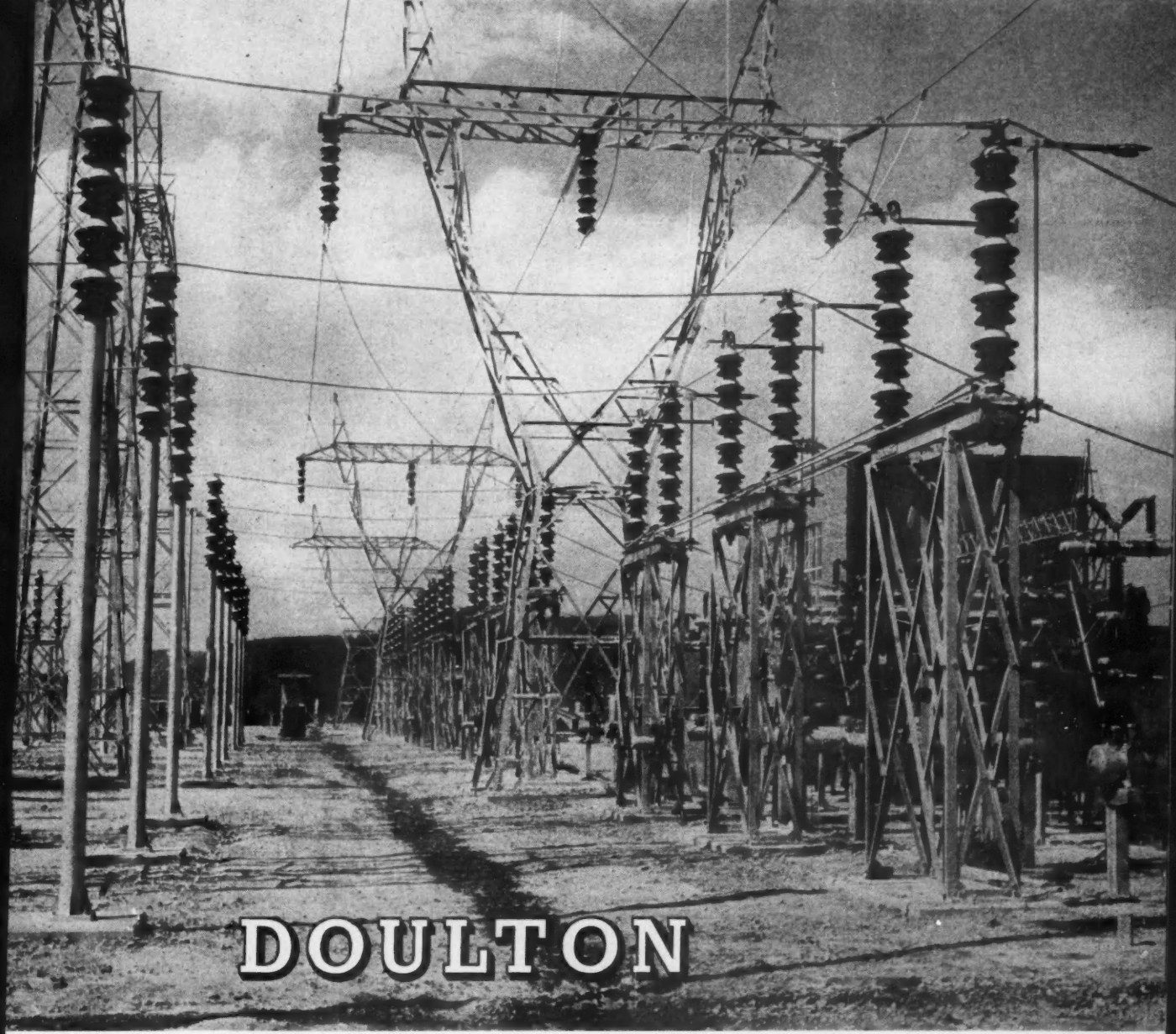

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220 kV in Tasmania

Doulton BB 26 post insulators, for 220 kV working voltage, installed at the Chapel Street sub-station near Hobart of the Hydro Electric Commission of Tasmania. This station will eventually be enlarged to 560 MVA to supply the Hobart district.

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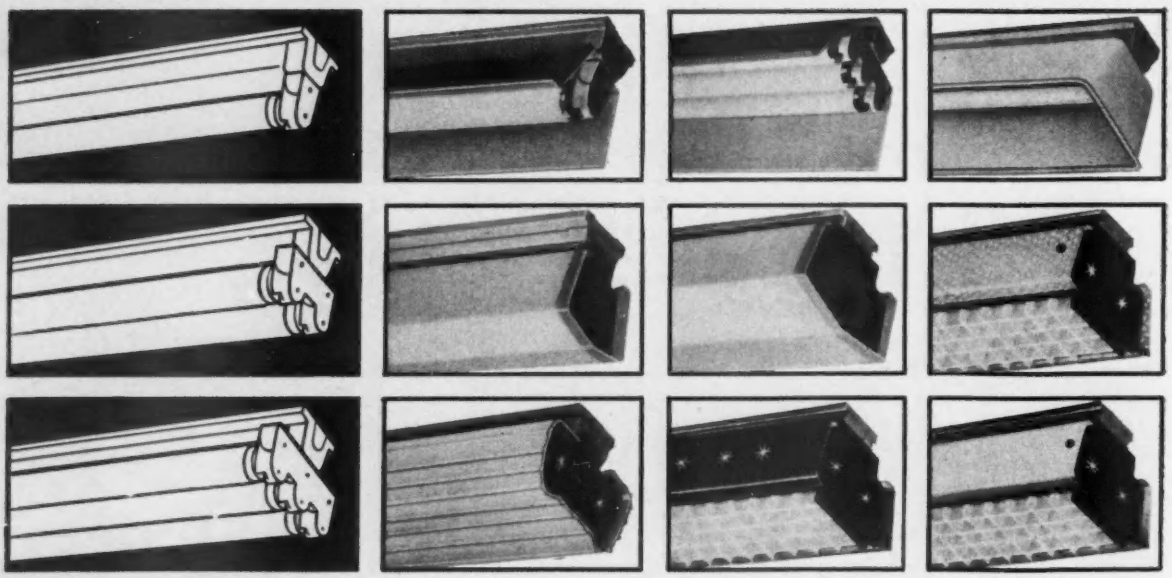
- *Philips Streamlite gives you Switch and Switchless start in the popular sizes.*
- *There is a choice of one, two or three lamp fittings – all equipped with Philips even slimmer Polyster ballasts.*
- *There is a fine range of diffusers and reflectors.*
- *It is extraordinarily reasonable in price.*
- *B.S. Box fixing and conduit entries at 24" centres. (B.S. 2467) 2 ft. 20w. 17½" centres.*
- *Variable fixing centres for B.S. Boxes where used with slide-grip hangers.*
- *For single and continuous mounting.*
- *Philips Sprung Rotor lampholders with earth plungers for lamp end-caps – rapid fixing, automatic positioning.*
- *10 amp. mains terminal block, and earth connection.*
- *Full length back plate with rigidly secured cast alloy ends providing earth continuity for end-entry conduit.*
- *Easily removed plastic inserts for end-conduit entries.*
- *Cable way for through wiring: cable cleats provided.*

They'll be in big demand – order now!



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WYLEX 20 amp Switches (DP/AC) are available Surface All-Insulated in Brown or Ivory with or without the Pilot Light. Also supplied with or without moulded Pattress (enables compliance with I.E.E. Regulation 207 G.) Also Flush with All-Insulated Cover and Surface Metalclad with and without Pilot Light.

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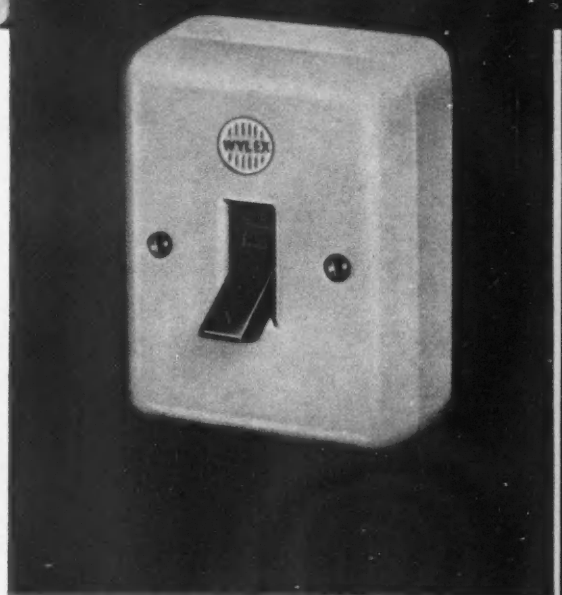

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SWITCHES · PLUGS & SOCKETS

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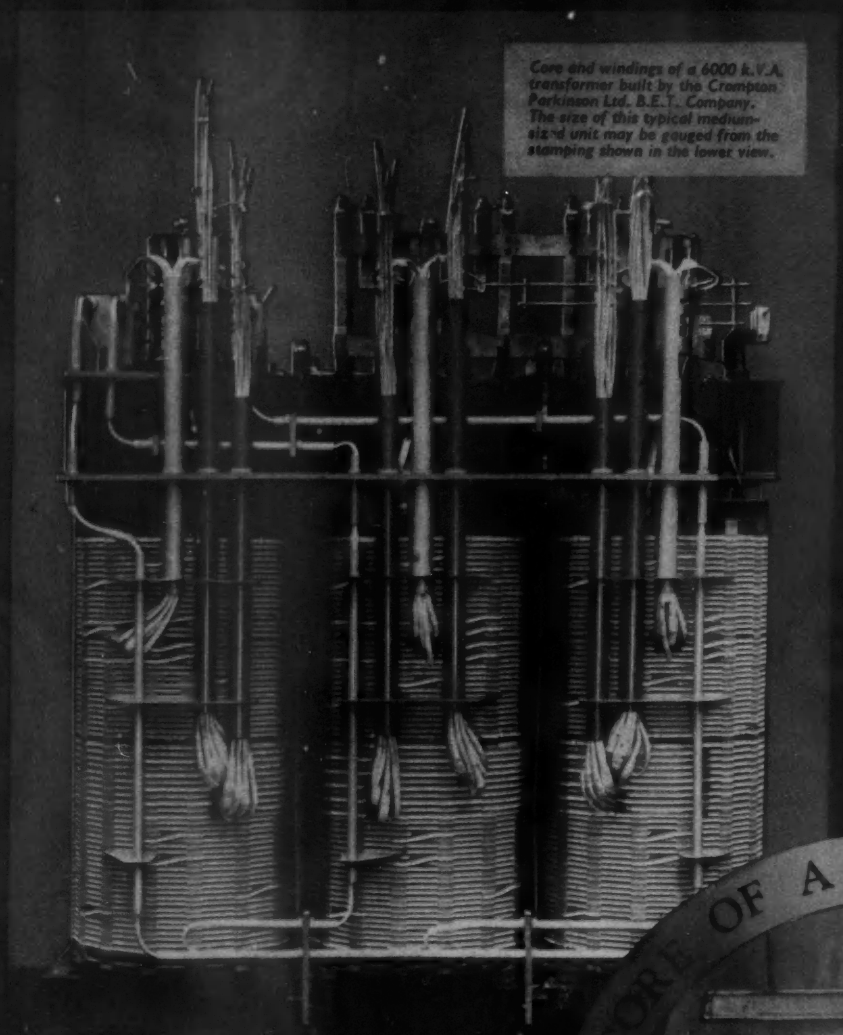
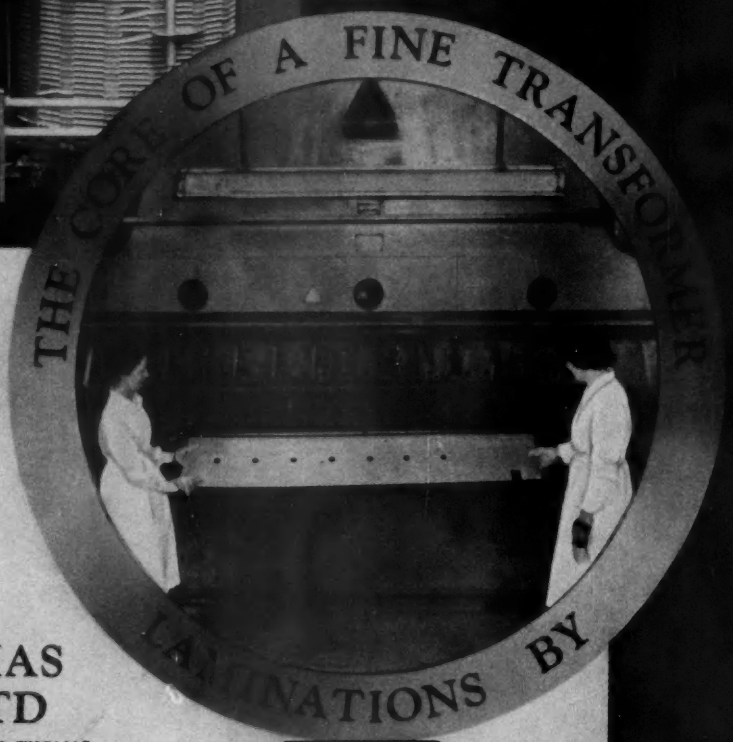


Core and windings of a 6000 k.V.A. transformer built by the Crompton Parkinson Ltd. B.E.T. Company. The size of this typical medium-sized unit may be gauged from the stamping shown in the lower view.



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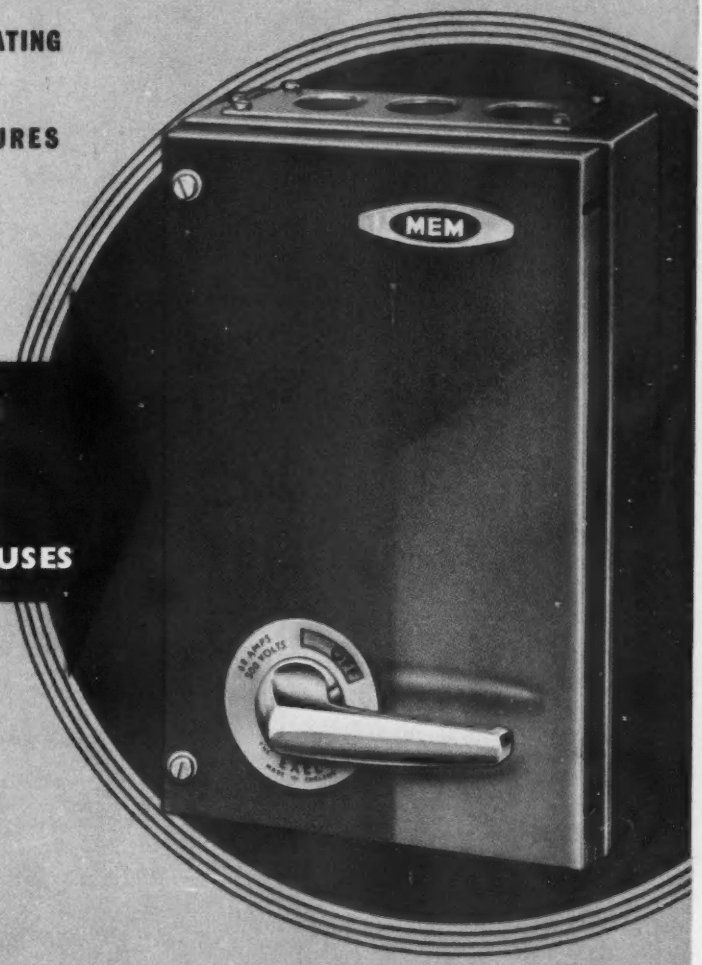
15, 30, 60, 100 AMPS



'EXEL'

SWITCHES AND SWITCHFUSES

- Fabricated cases are of heavy gauge sheet steel with hinged covers, rustproofed and finished grey stove enamel.
- The "Exel" range is fitted with chrome plated front operating switch handles, a feature which permits more compact assemblies on switchboards or panels.
- The "ON" and "OFF" positions are clearly shown by an indicator associated with the switch handle.
- Fuse bases are of the new "Kantark-Exel" pattern, which will accept semi-enclosed rewirable or H.R.C. cartridge fuse carriers.
- M.E.M. H.R.C. cartridge fuse carriers are designed to accommodate H.R.C. cartridge fuse-links to B.S.88:1952, Appendix 'J' Dimensions, Form A—Offset Tags.
- M.E.M. H.R.C. cartridge fuse-links are available for use with this range of switchgear, and have been A.S.T.A. certified for Category of Duty 440 AC3 (16,500 amps), 440 AC4 (33,000 amps) and 440 AC5 (46,000 amps).
- "Exel" switches comply with the relevant Temperature Rise, and Making and Breaking Capacity Tests of B.S.861: Part 1, 1955, and switchfuses with B.S.2510:1954.

. . . and so many other features, too

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- **Full heavy-duty contact rating.**
- **Positive pressure connections.**
- **Clearly marked terminals for easy wiring.**
- **Button guard available to prevent accidental operation.**
- **Full range of voltage ratings.**
- **Choice of 6 colourcaps.**
- **Same single-hole mounting as other oil-tight units.**

May we introduce Alec Trician—illuminated above—the knowledgeable electrical chap. You'll be seeing him again, pointing out the wisest choice in electrical control gear.

A *Complete* LINE OF OIL-TIGHT CONTROL UNITS

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and that's not all!
For the on-load tap changing gear of transformers up to the largest size, Ferranti Ltd. choose Fibreglass Reinforced Phenolic Premix Mouldings. Why? First, because their structural and impact strengths are extremely high. Second, because their electrical insulation properties are outstanding. Third, because they eliminate the need for complicated built-up sheet, rod and tube insulation.
With Fibreglass Premix Mouldings, components such as this are more efficient, cheaper and simpler — sensationally simpler!
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Special plant? Not necessarily. In many cases normal compression moulding will do

Moulded by Ferranti Ltd.

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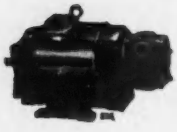
GENERATORS up to 700 kVA



BELFAST · BRISTOL · CARDIFF · DUBLIN · DUNDEE · GLASGOW · HULL · LEEDS · LIVERPOOL
LONDON · MANCHESTER · NEWCASTLE · PETERBOROUGH · SHEFFIELD · WOLVERHAMPTON

Wootton meter boards are Trumps!

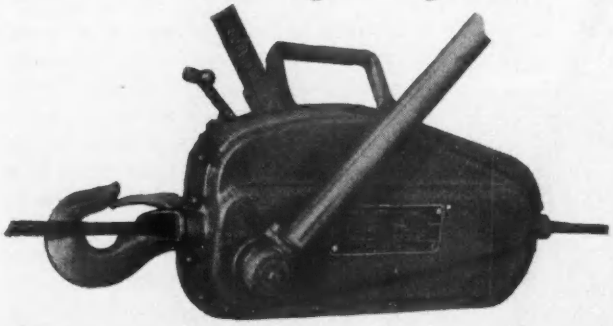
Naturally . . . when they're Wootton-made . . . and Wootton-tested! They're made of the best plywood Wootton could lay hands on. Tested for reliability . . . toughness . . . durability. Wootton meter boards stand up to anything. Even in the most extreme climates. No contraction or expansion or warping with Wootton! Oh, and there's more to Wootton than just meter boards. They make wood blocks too, and instrument cases, and they're aces at sunk switch boxes.

WOOTTON–the meter board people

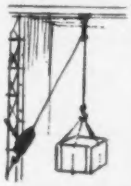
WOOTTON & CO. LTD
ALMA WORKS · PONDERS END · MIDDX
Telephone: HOWard 1858

There's always a job for the TIRFOR

by appointment to Electricity



ANY HEIGHT OF LIFT · ANY LENGTH OF PULL

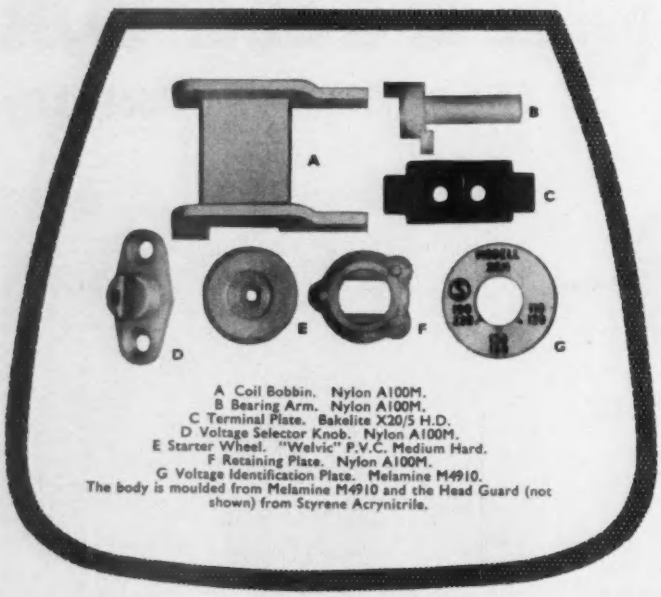


Installing transformers . . . Erecting power-lines . . . Loading, hauling, lifting or lowering, the powerful TIRFOR machine gives a controlled, reversible pull over any distance. It can be used anywhere. It is carried and hand-operated by one man. The TIRFOR T13, with a mechanical advantage of 43, lifts a ton. The TIRFOR T35, with a mechanical advantage of 85, lifts 3 tons.

TIRFOR LIMITED
ONE OF THE SIMM ENGINEERING GROUP
27 BROOMGROVE ROAD · SHEFFIELD 10 · Tel: 64436

London: 'Phone, Terminus 6558. Scotland: 'Phone, Kirkintilloch 2468. S.Wales: 'Phone Bridgend 4061.

ONCE AGAIN!



A Coil Bobbin. Nylon A100M.
B Bearing Arm. Nylon A100M.
C Terminal Plate. Bakelite X20/5 H.D.
D Voltage Selector Knob. Nylon A100M.
E Starter Wheel. "Welvic" P.V.C. Medium Hard.
F Retaining Plate. Nylon A100M.
G Voltage Identification Plate. Melamine M4910.
The body is moulded from Melamine M4910 and the Head Guard (not shown) from Styrene Acrynitrile.

In 1959 we published a series of three advertisements giving details of our services in connection with the Sunbeam Shavemaster. The fact that we can now give details of the Sunbeam Rollmaster Electric Shaver speaks for itself.

It is interesting to note that shavers assembled from mouldings produced—and tooled—by us, are now being sold on the other side of the Atlantic.

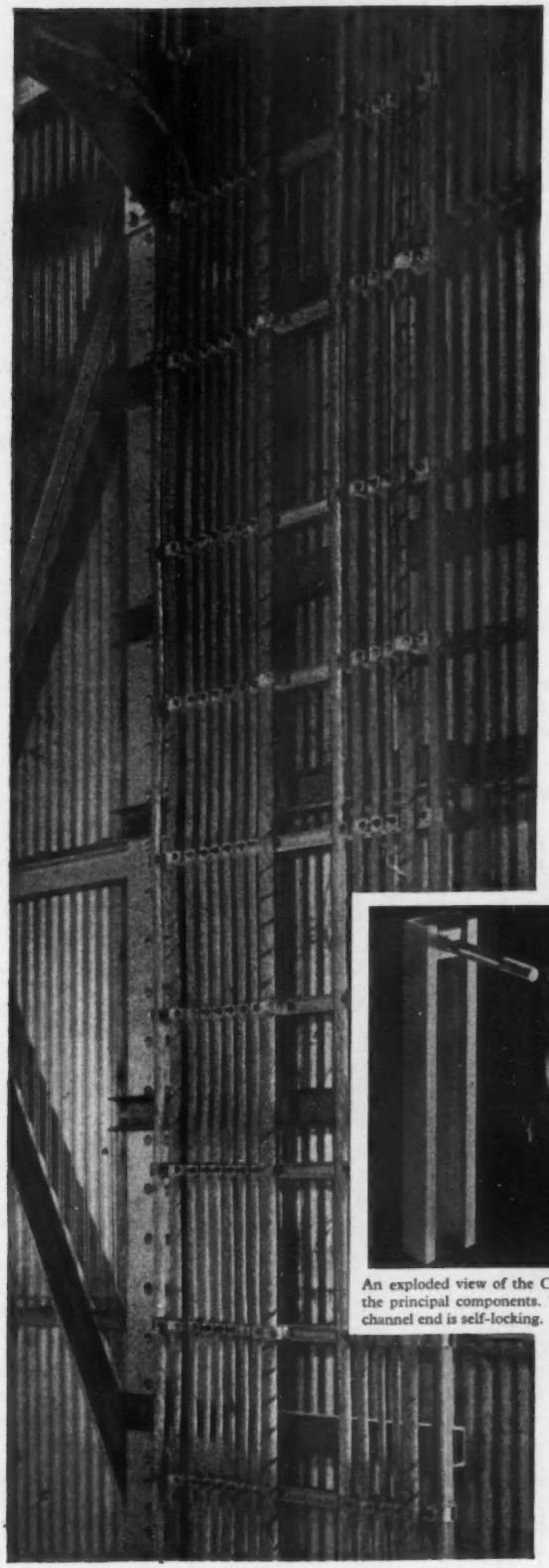
The new Sunbeam Rollmaster Electric Shaver is a superlative shaving instrument and incorporates mouldings in a wide variety of plastics. In fact the 22 mouldings involved required five different materials each selected to do a specific job. When quantity production to precise limits is required, and, particularly, when flawless surface finish is essential, we have the plant, resources and technical " know-how" to ensure complete satisfaction. May we quote for your next job?

Sunbeam choose E. Elliott Ltd

THE PLASTIC
MOULDERS WITH THE ENGINEERING
BACKGROUND

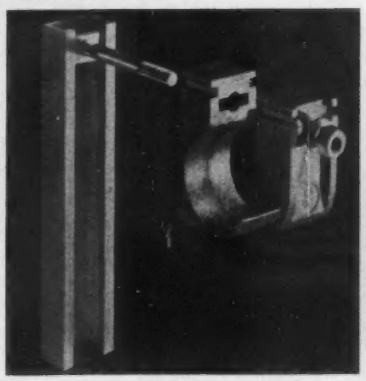
315 SUMMER LANE, BIRMINGHAM 19. Telephone : ASTon Cross 1156 (4 lines)

LEEDS POWER STATION USES CS CABLE SUPPORTS

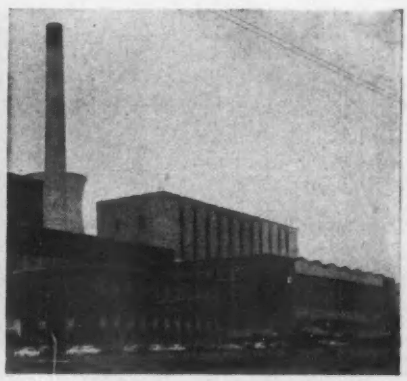


This immaculate cable run is part of the Central Electricity Generating Board's new installation at Skelton Grange 'B' Power Station, Leeds. It employs the new C.S system of cable supports which is gaining rapid favour everywhere. This system was chosen not only for its excellent appearance but also for the following outstanding advantages:

* The unique hook section eliminates manual holding of cable during fixing.
* A universal channel section simplifies adaptation vertically and horizontally.
* All components are in aluminium alloy to B.S. 1490 and 1476 for maximum corrosion resistance.
* Careful design combines good appearance with economy.
* The cost is less, both initially and in installation.
* Sizes cater for cables $\frac{1}{2}$" to 3" diameter.



An exploded view of the C.S. system showing the principal components. The backnut at the channel end is self-locking.



C.E.G.B.'s Skelton Grange 'B' Power Station, Leeds. Consulting Engineers: Merz and McLellan. Contracting Engineers for Cabling Installation N. G. Bailey & Co. Ltd.

CS CABLE SUPPORT OUTDATES OTHER SYSTEMS

For detailed information and prices contact

CABLE SUPPORTS LIMITED

301 BRIXTON ROAD · LONDON · S.W.9

Telephone: Brixton 1103/5696

PIRELLI GENERAL

CABLES

More than equal to the extra service demanded

These cables are obtainable from the G.E.C. Installation Equipment Group or direct from Pirelli-General Cable Works Ltd.

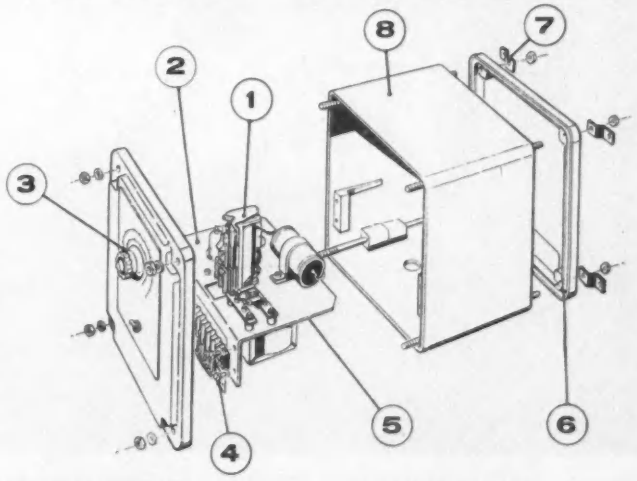
PIRELLI-GENERAL CABLE WORKS LTD., SOUTHAMPTON

Exterior showing calibrated dial covering two typical ranges.

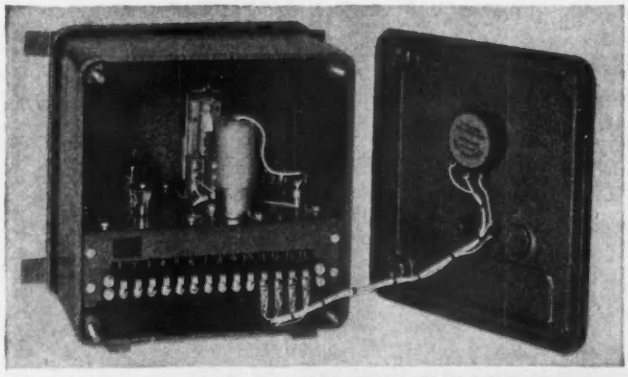
Now-flexible precision timing for *low cost* automatic control

This new timer, either as an individual unit or grouped in a multi-interval installation, can be electrically initiated or interlocked to provide a simple solution to complex sequencing and automatic control requirements.

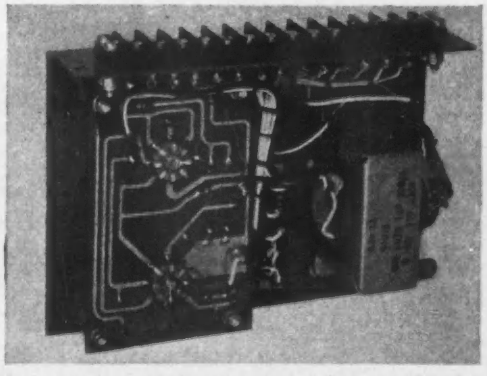
Designed to high engineering standards and up to the minute techniques, this rugged timer unit in dust and moisture sealed cast alloy case is available in six versions with overlapping time ranges from 0.1 to 500 seconds. Directly time-calibrated dial permits precision setting to match the repeat accuracy capability of the unit. For further details write to Standard Products Division for Publication D.6111-01.



1 Application proved relay with heavy duty contacts
2 Easily withdrawable chassis
3 Time calibrated dial for accurate setting
4 Accessible customers' connections
5 Printed circuit sub-chassis
6 Case sealed against ingress of dirt and dust
7 Adaptable mounting arrangements
8 Cast light alloy case



Sealed front cover removed showing simplicity and ease of access.

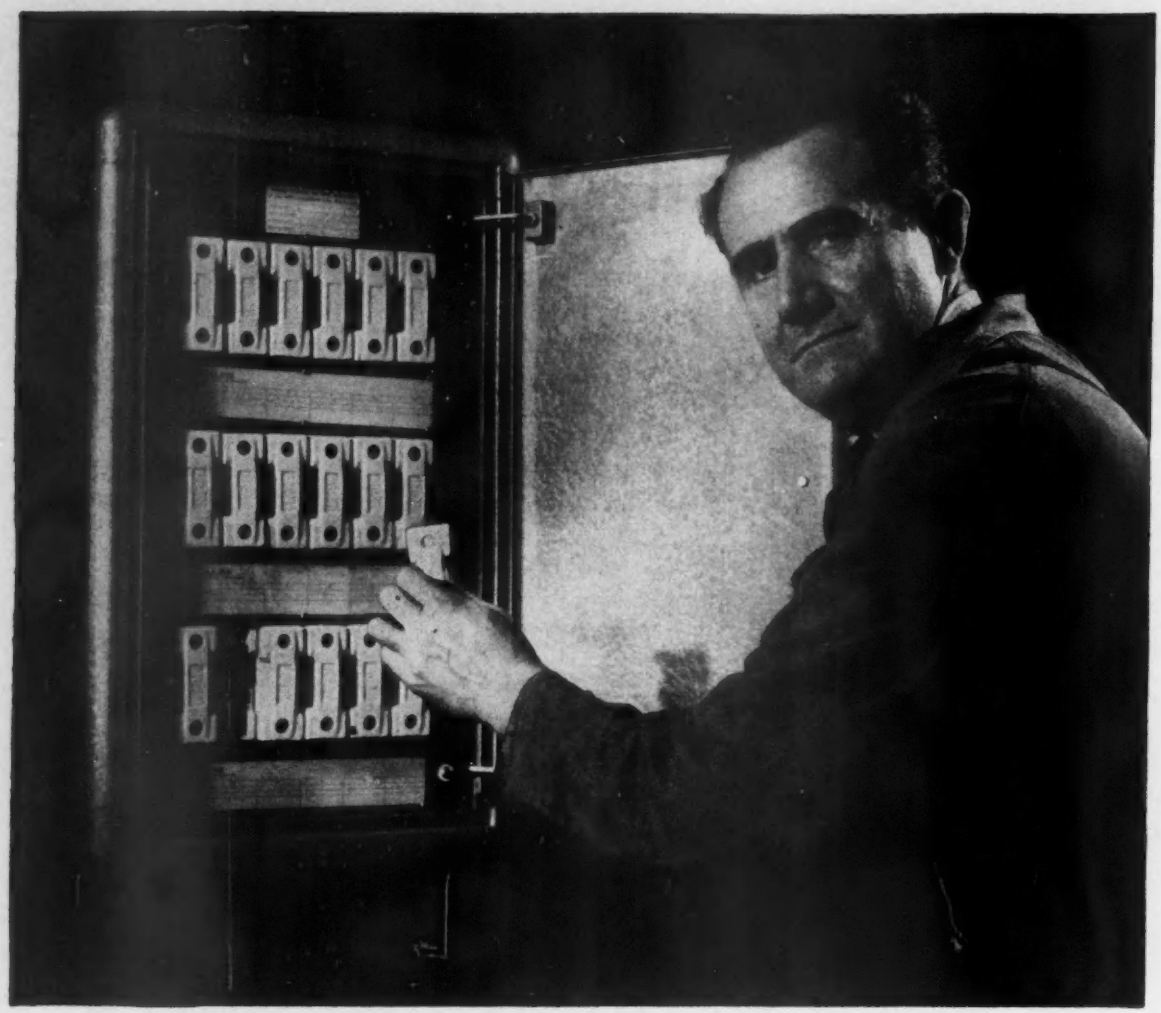


Printed circuit construction ensures high performance at low cost.

LANCASHIRE DYNAMO ELECTRONIC PRODUCTS LIMITED

S.P.6 RUGELEY · STAFFORDSHIRE · ENGLAND Metal Industries Group

Manufacturers of the world's widest range of industrial electronic control equipment



simply a matter of confidence

Ask any experienced electrical man. He'll tell you right away that you can have absolute confidence in anything Sanders make. No ifs, buts or doubts. If it's a Sanders job it's the best obtainable and it will never let you down. Take the SANDALINE Fuseboard, for instance, designed to meet today's modern requirements. With its ingenious smooth line case, detachable ends and sides, the 'Sandaline' has easily reversible fusebanks all making for ease and speed of wiring. Rewirable or H.R.C. Fuse Carriers can be fitted at will, since the 'Sandaline' has the tried and proved 'Sandaspeed' Duplex Fuse Units originated by Sanders. Absolutely rigid and dustproof, and incorporating a cylinder type lock with interchangeable keys, the 'Sandaline' Fuseboard is finished in steel-hammered grey stove enamel inside and out. But that's not all. It's a quality job. It's that little bit better than the best. In short, it's a Sanders job.

SANDERS

WILLIAM SANDERS & CO. (WEDNESBURY) LTD. - FALCON ELECTRICAL WORKS - WEDNESBURY - STAFFS.

NEWS SHEET

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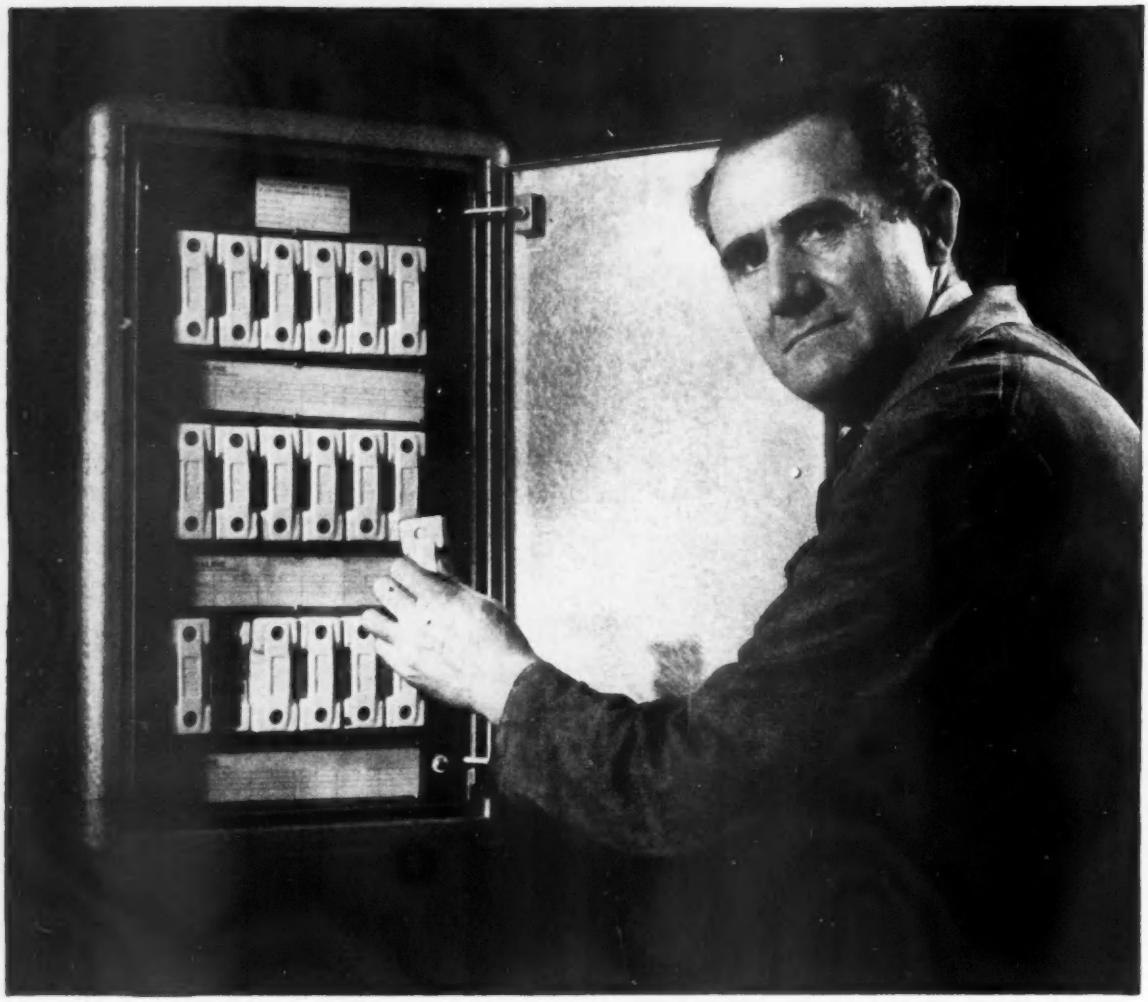

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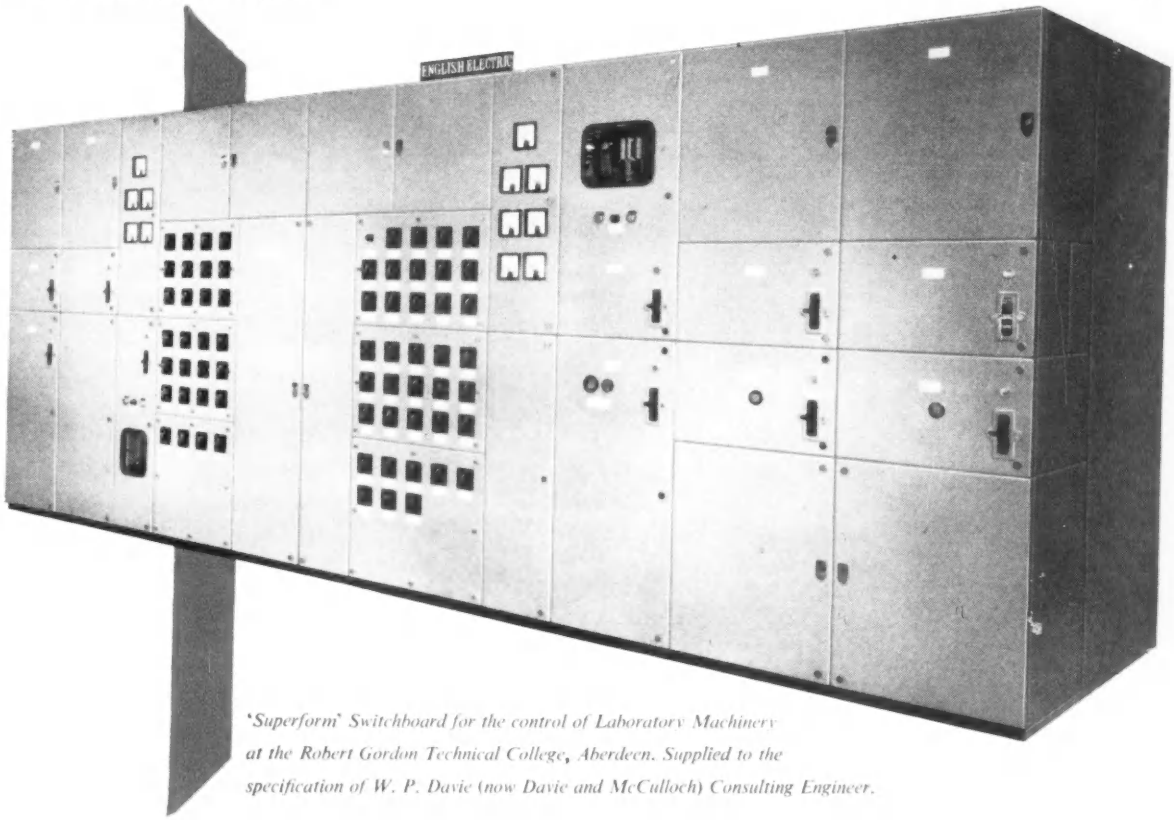

'Superform' Switchboard for the control of Laboratory Machinery at the Robert Gordon Technical College, Aberdeen. Supplied to the specification of W. P. Davie (now Davie and McCulloch) Consulting Engineer.

'SUPERFORM' SWITCHBOARDS

for all industrial distribution schemes

Composite boards can be supplied covering all the requirements of modern M.V. systems, the range of equipment including:

- Air circuit-breakers up to 3,000 amps.
- Off-load isolators up to 3,000 amps.
- Load-breaking fuse-switches up to 750 amps.
- Contactor gear for motor starting or other duty
- Distribution fuseboards
- Instruments, meters and relays of all types

Plus

- Modern styling and pleasing appearance
- Unique design features giving increased safety to operating personnel
- Easy access for cabling and maintenance
- Fault making capacities up to 50 MVA at 440 volts
- Complete short-circuit protection

'ENGLISH ELECTRIC'
fusegear

THE ENGLISH ELECTRIC COMPANY LIMITED, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2.

Fusegear Division, East Lancashire Road, Liverpool, 10

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FG.57

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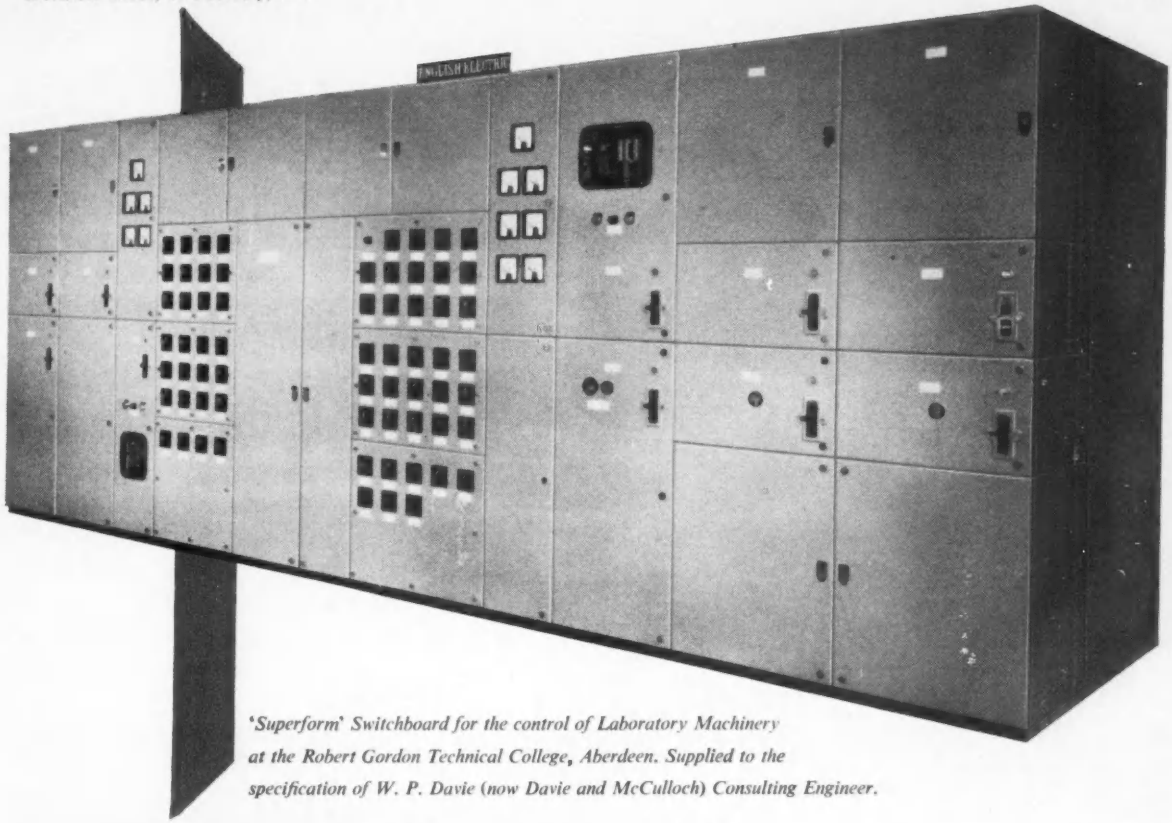

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fusegear

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Fusegear Division, East Lancashire Road, Liverpool, 10

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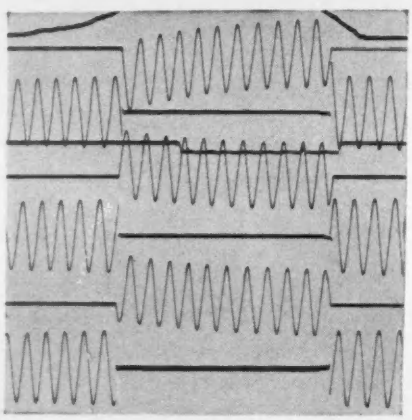
FG.57

Testing plays a larger part in the development of switchgear than of most plant. And it is not a matter of subjecting a circuit-breaker to a heavy overload to see whether it blows up. On the contrary, to the non-specialist observer a test is an almost ludicrous anti-climax. The build-up is impressive; long preparation, elaborate fire precautions, the switchgear itself as distant as the target in a rifle range and watched through armoured glass. A warning hooter clears the site. Then the test engineer presses a control switch . . . in complete silence absolutely nothing happens, and the test—another 'shot'—is over. But a battery of oscillographs has recorded on photographic film a complete history of everything of importance that happened inside the switch. This is one approach to . . .

This thing called know-how



Any new design or improvement of an existing one involves many such tests of numerous detailed innovations. They are the means by which the designer checks his work as it proceeds. Ready access to test facilities is thus an essential of his work. We are fortunate in having at Chelmsford one of the most up-to-date (ASTA) testing stations in the country, and this has played a most important part in the evolution of all our switchgear. But there is another side to know-how which comes from sheer experience—and we have had 80 years of that.

Crompton Parkinson LIMITED

ELECTRICAL EQUIPMENT

OWNERS OF AN APPROVED ASTA TESTING STATION

Makers of Electric Motors of all kinds, A.C. and D.C. Generators, B.E.T. Transformers, Switchgear, Cables, Instruments, Lamps, Lighting Equipment, Batteries, Stud Welding Equipment, Traction Equipment, Ceiling Fans.

CROMPTON PARKINSON LTD., CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2.

S611

FULLY TESTED

REPEATER UNIT

for use with the

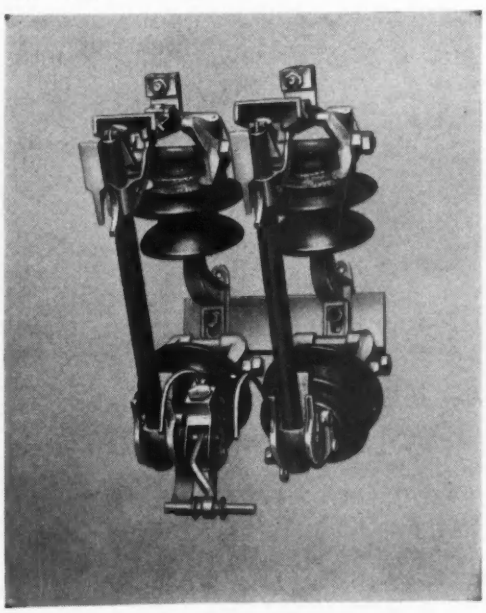
NEW 150 MVA, 11 kV Type 'D' FUSE-SWITCH

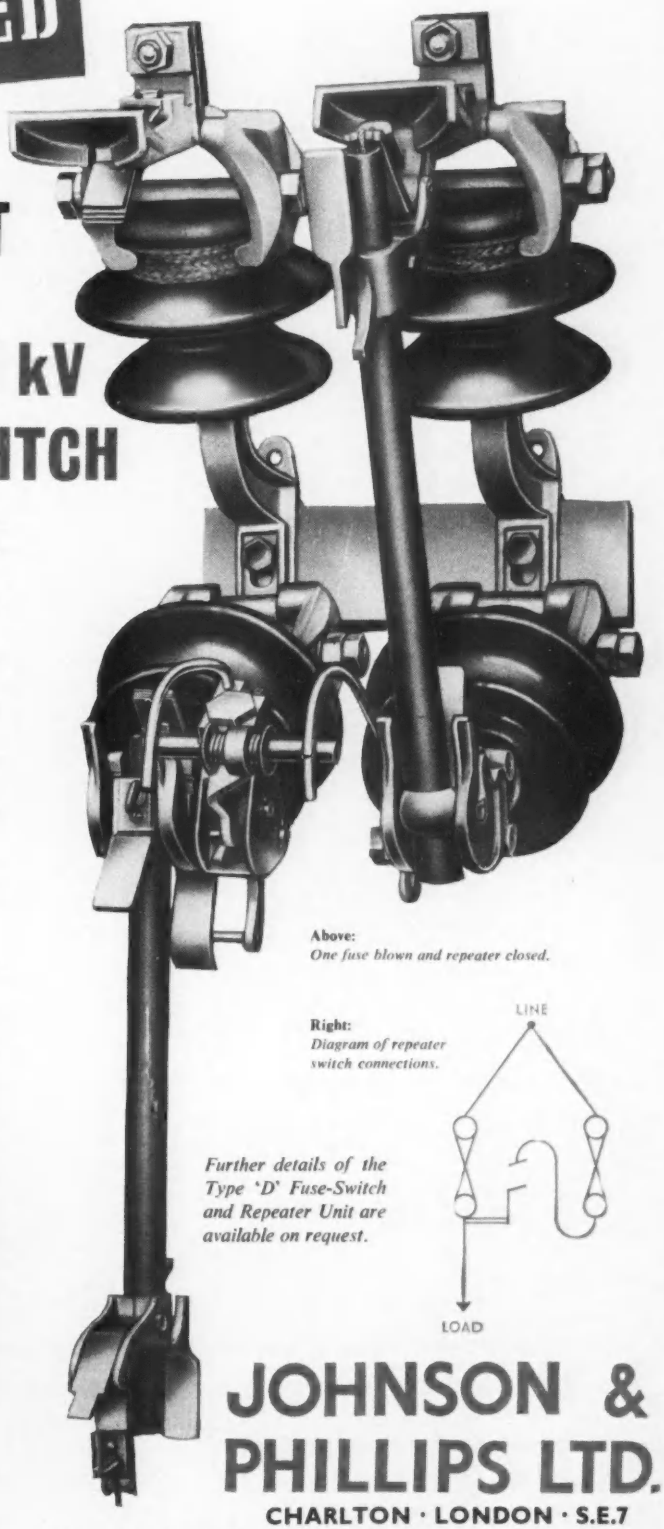
To match the performance of the new Type 'D' Expulsion Fuse-Switch, J. & P. now introduce a repeater unit to provide automatic restoration of overhead line supplies after momentary faults have cleared.

The majority of faults on overhead lines are of a transient nature and the cause is usually destroyed by the resultant power arc. In such circumstances the Repeater Unit will introduce a second expulsion fuse-switch into the circuit, after the first fuse has blown, and automatically restore the circuit. If the fault is sustained, the second fuse will blow.

The Repeater Unit has been thoroughly tested at the C.E.S.I. Laboratories, Milan, for operation at all current values up to 8000 A at 11 kV.

Below:
J. & P. Type 'D' Fuse-Switch repeater with both fuses intact and repeater open.





Above:
One fuse blown and repeater closed.

Right:
Diagram of repeater switch connections.

Further details of the Type 'D' Fuse-Switch and Repeater Unit are available on request.

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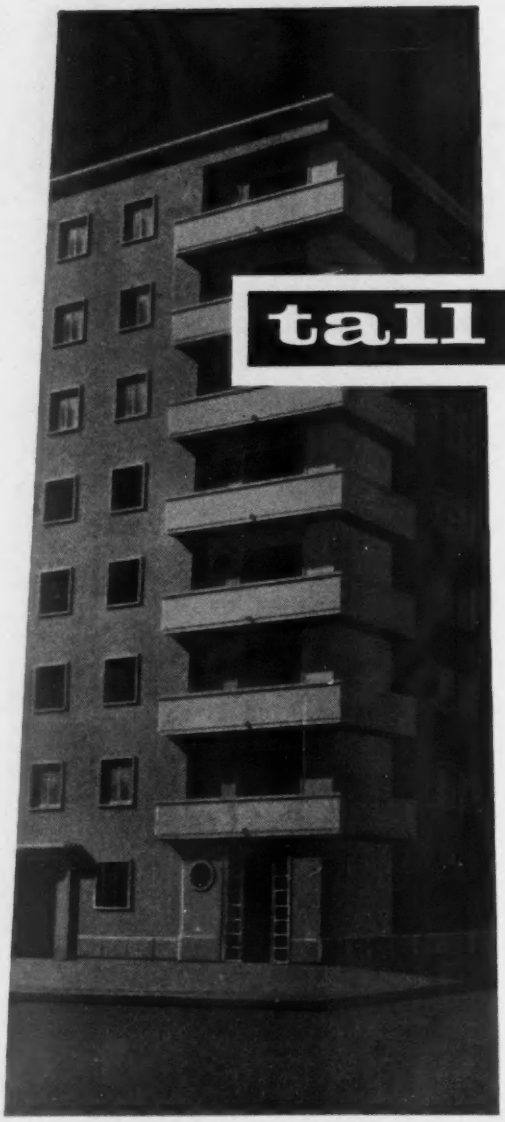

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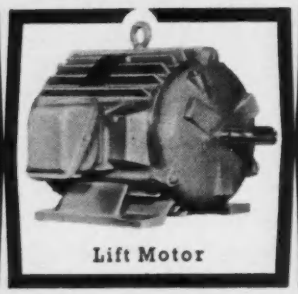
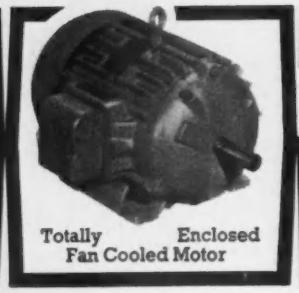


Lift Motor



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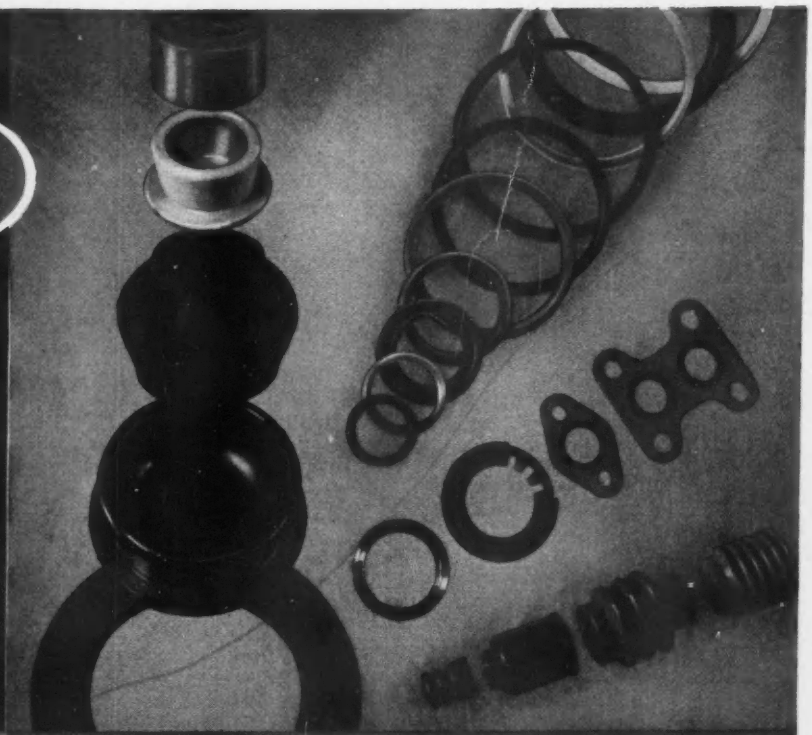

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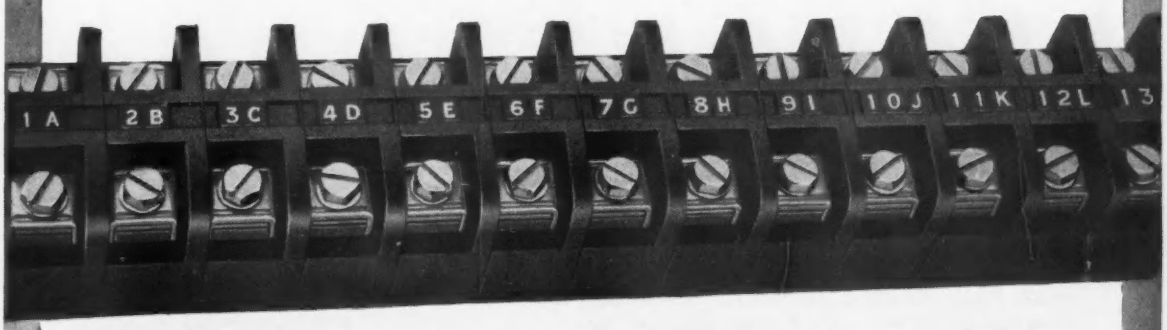
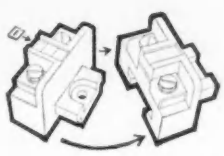


MTE MULTI-LOCK TERMINAL BLOCKS



With Multi-Lock you can build up complete terminal block assemblies consisting of any number of single units you choose. They are available in three ratings (15, 40 and 100 amp.) and can be mounted to any surface without special brackets or channels. The 40 amp. and 100 amp. blocks also interlock with one another to give two different ratings in one assembly. All Multi-Locks meet B.S.I. and C.S.A. specifications.

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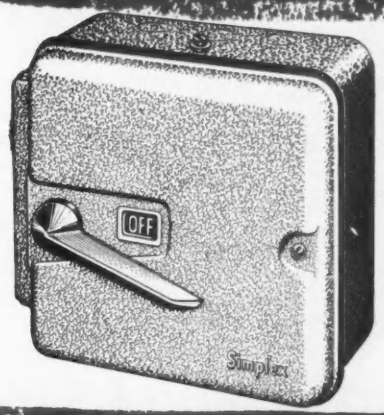

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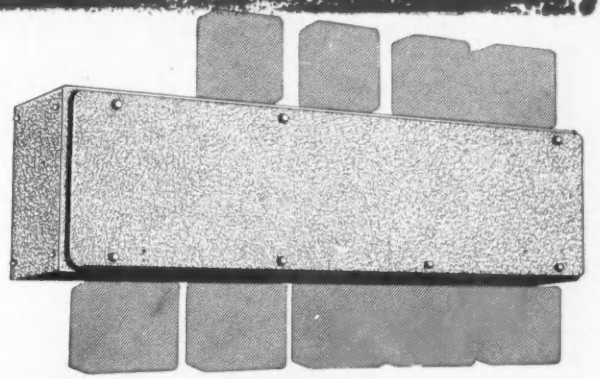
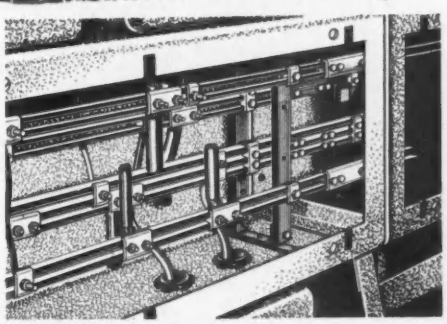
Star Switchfuse with cover open showing interior hinged forward for ease of wiring.



Star Busbar Chamber.



Close up of interior of Star Busbar Chamber showing main branch terminals, and busbar arrangements.

Cables cut away for purpose of illustration

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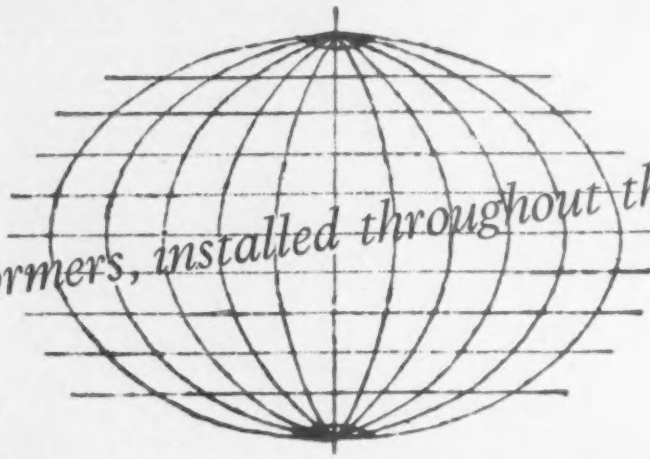

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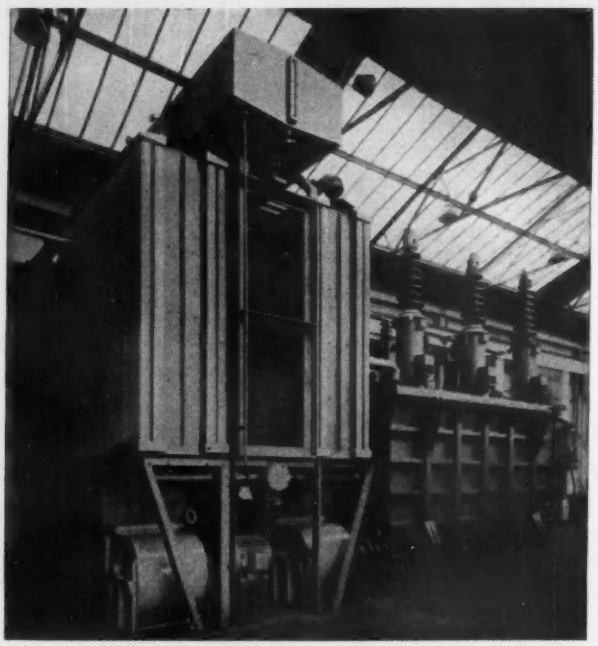

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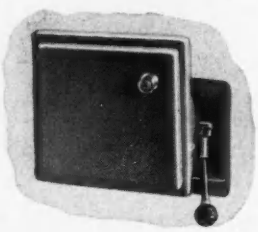

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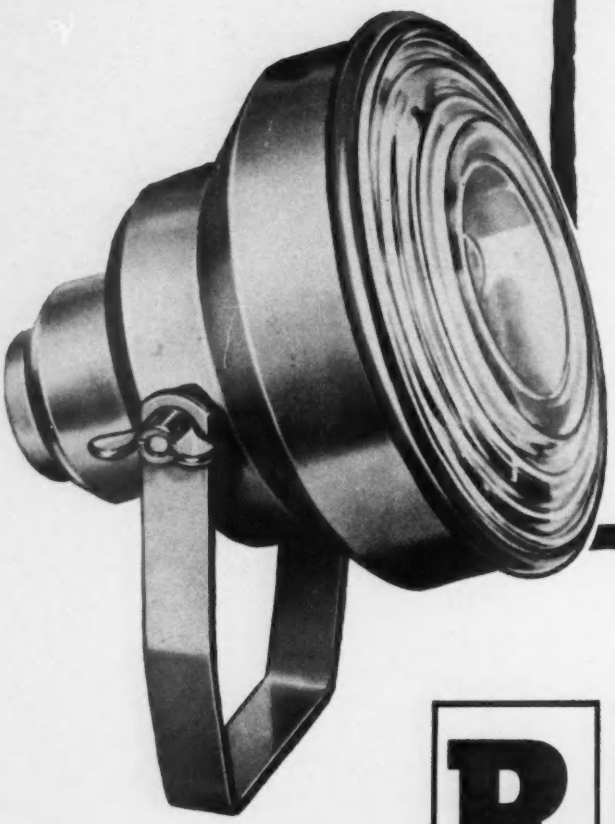

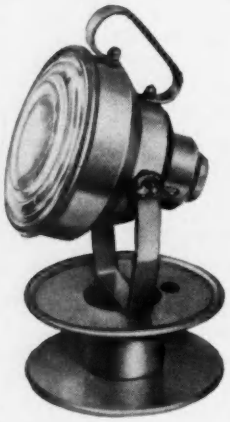

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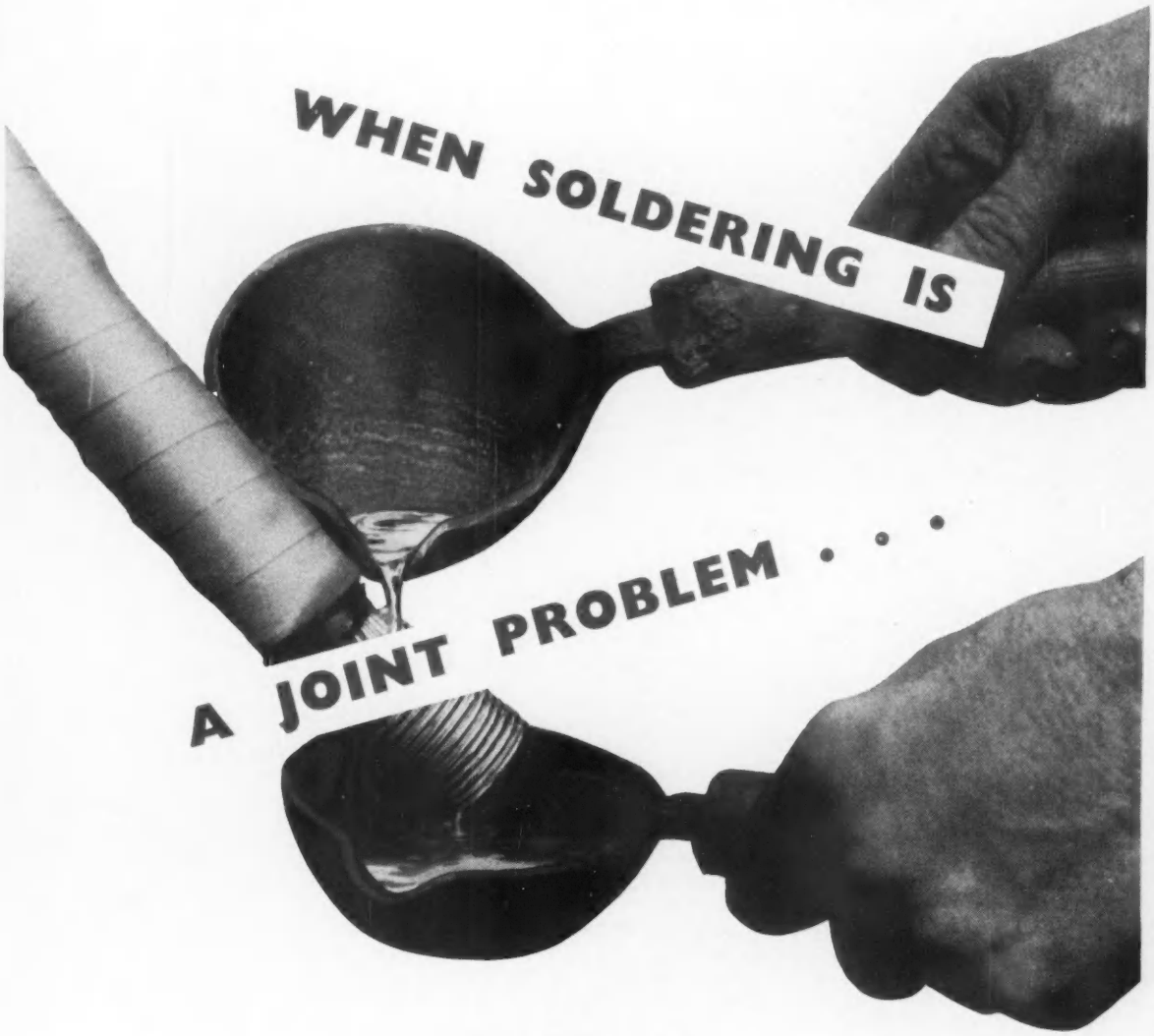

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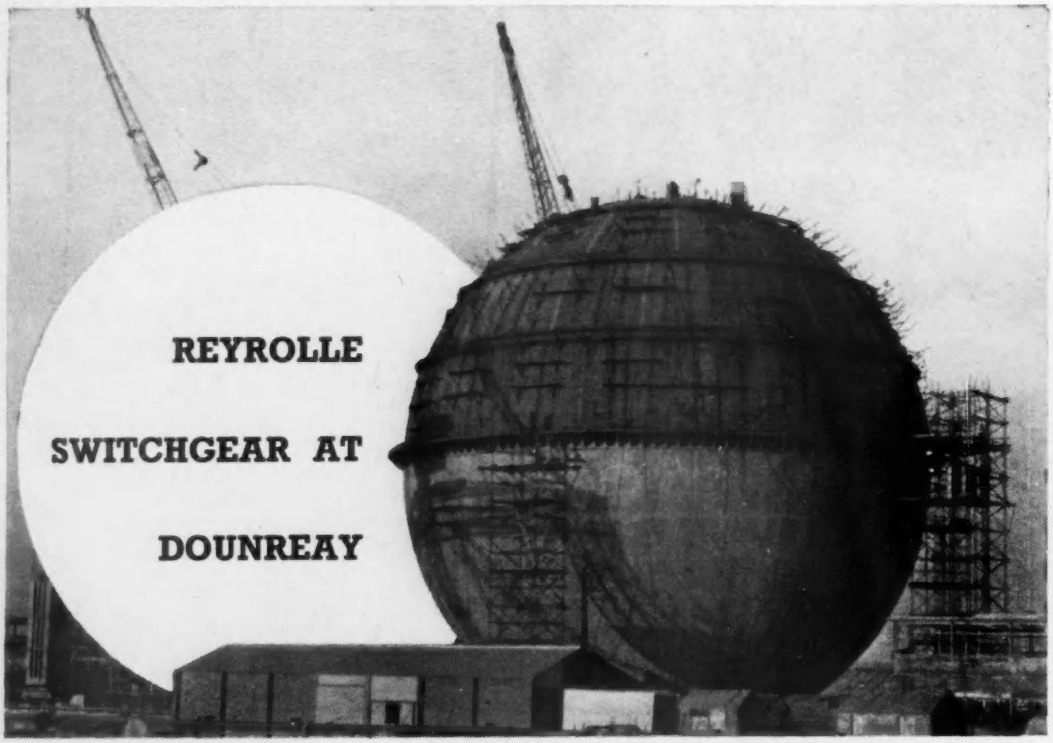
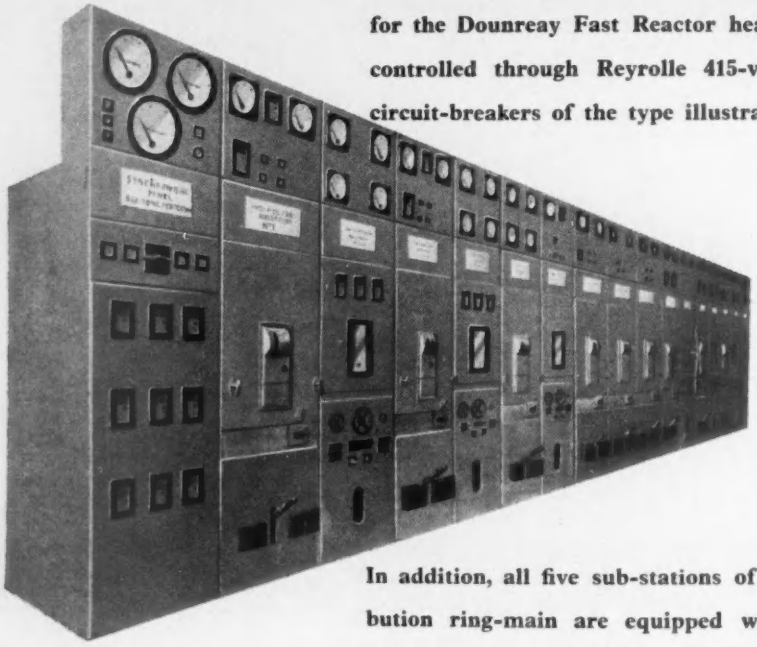


Photograph by courtesy of the U.K.A.E.A

The electro-magnetic liquid-metal pumps and other services for the Dounreay Fast Reactor heat-exchanger system are controlled through Reyrolle 415-volt 31·5-MVA air-break circuit-breakers of the type illustrated.



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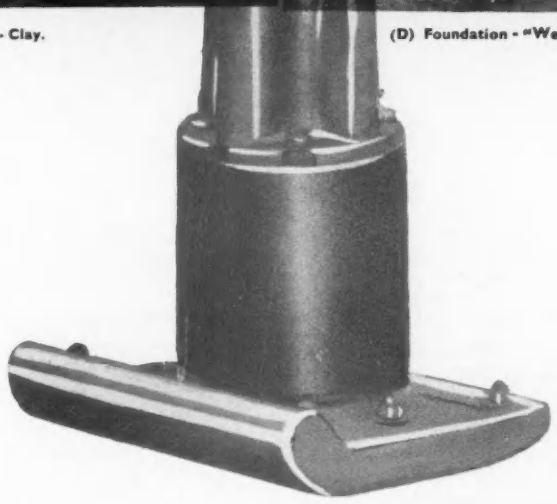

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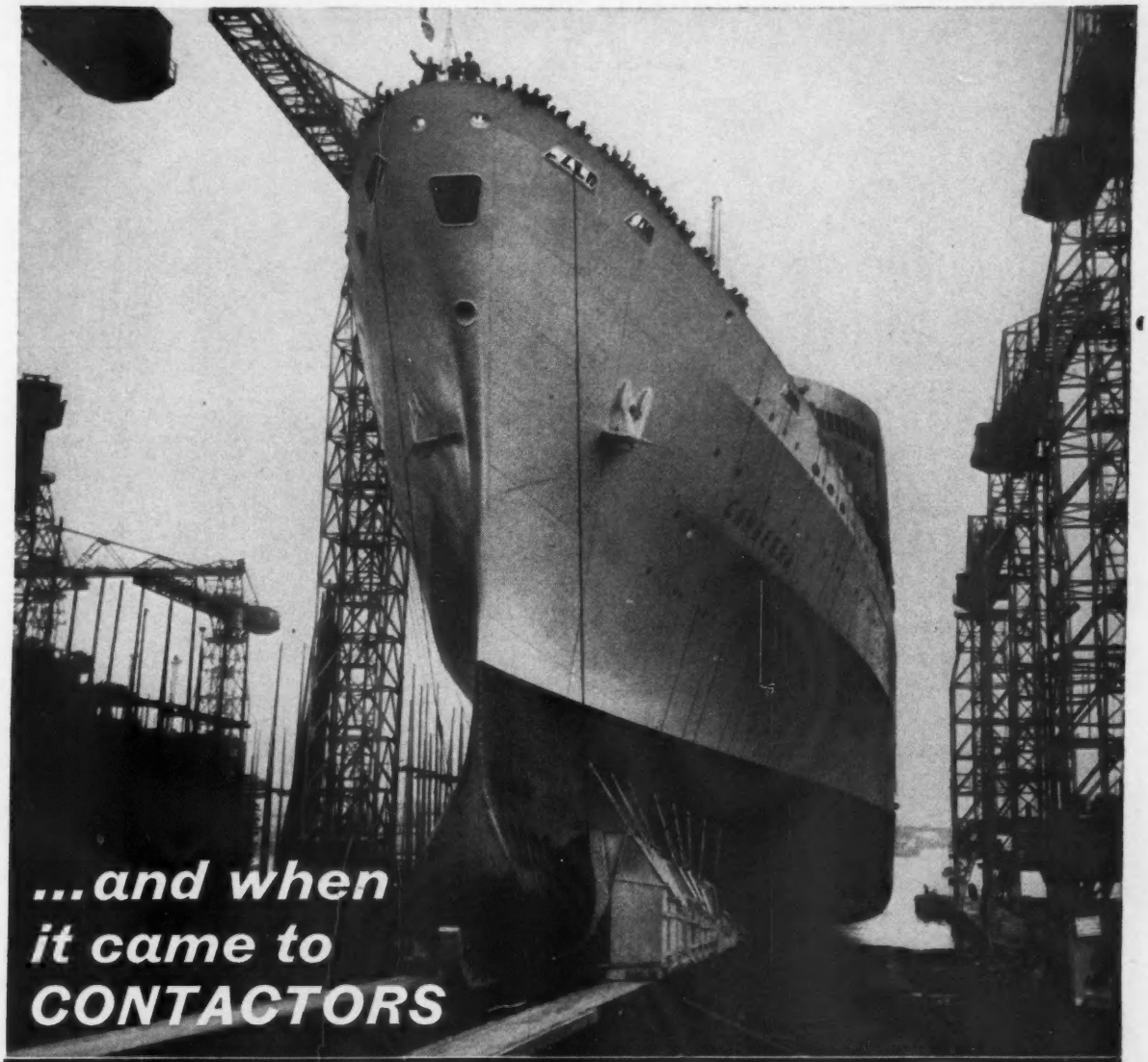

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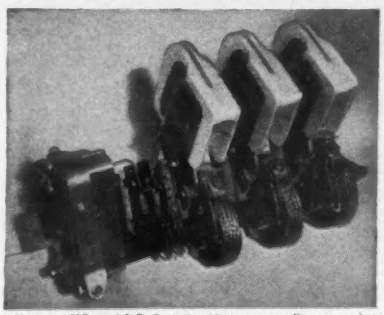

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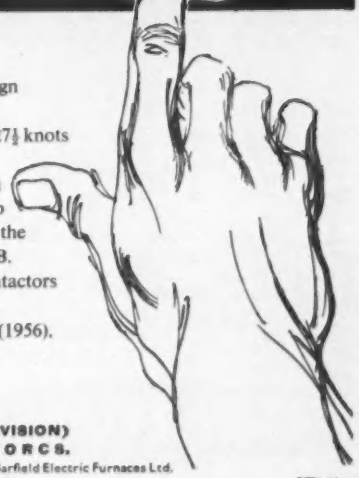

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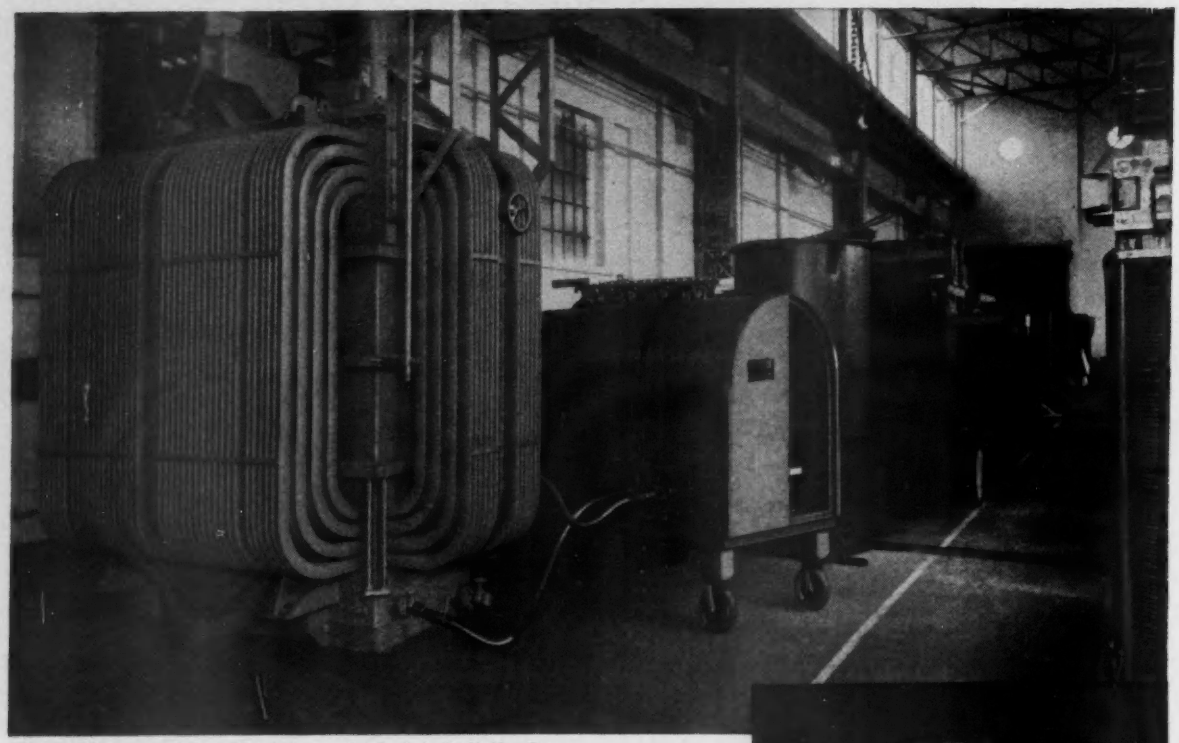

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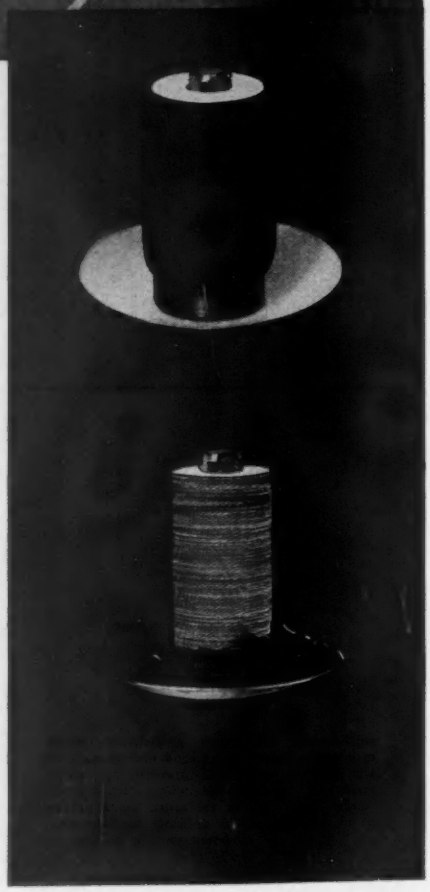

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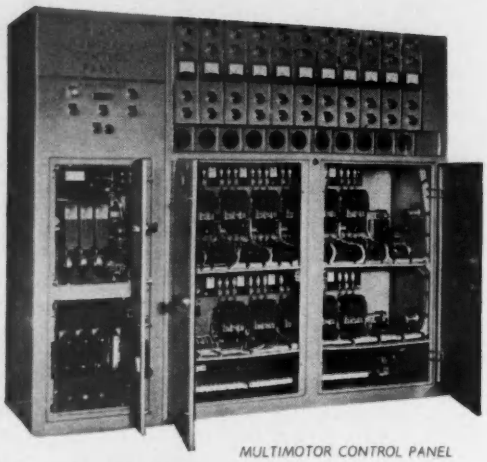

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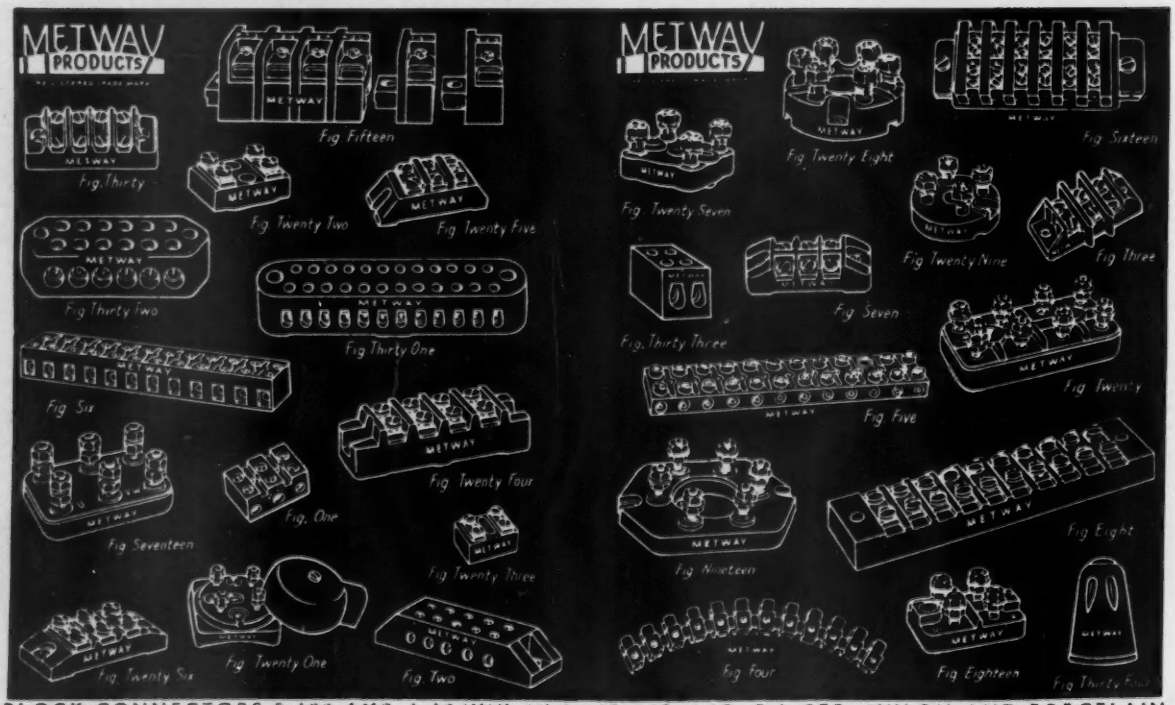

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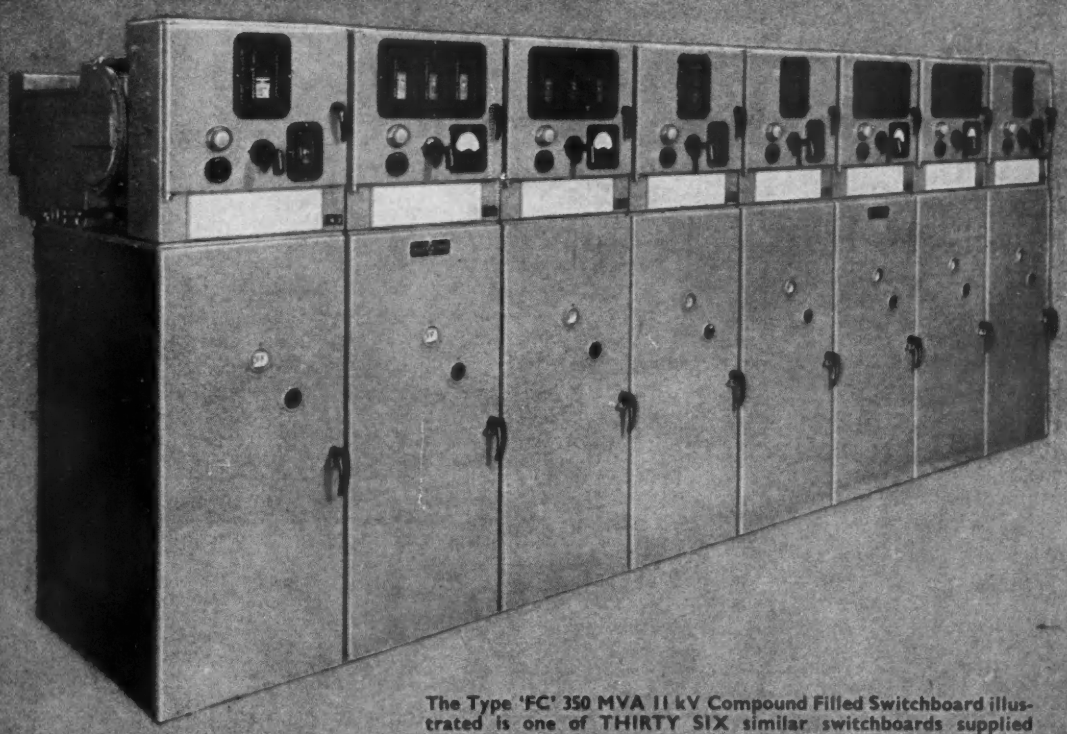

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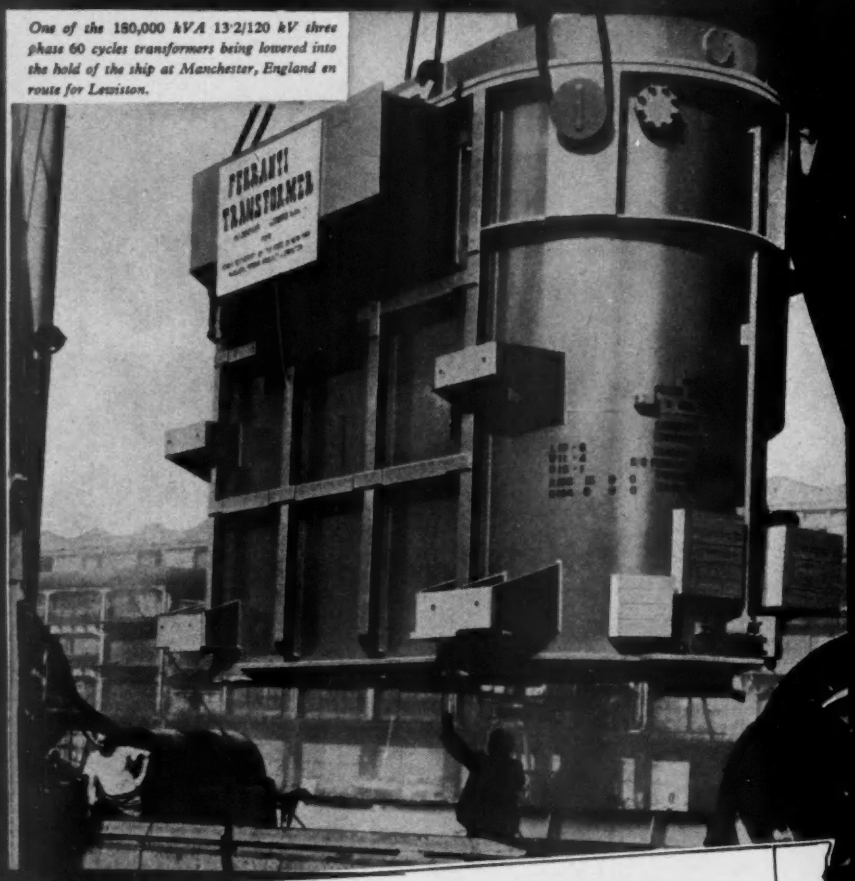

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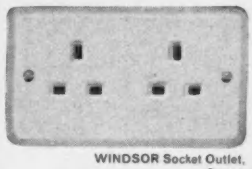
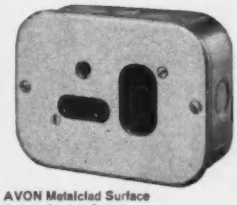
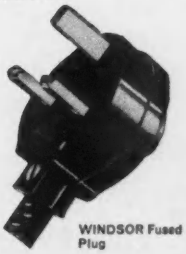

WINDSOR Socket Outlet, 2 gang

WINDSOR Surface Socket Outlet


AVON Metalclad Surface Switch Socket Outlet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THURSDAY 16 FEBRUARY, 1961
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ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
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Dans ce numéro

Longévité des isolants 239
Les isolants utilisés dans les machines électriques se détériorent avec le temps, la température et les efforts mécaniques imposés par la dilatation et la contraction thermiques des éléments métalliques intérieurs ou protecteurs. Plus de 50 ans de recherches effectuées par de nombreaux spécialistes n'ont résolu que partiellement les problèmes relatifs à l'évaluation de cette longévité dans des conditions spécifiques, mais on se sert déjà des connaissances acquises dans ce domaine pour évaluer le vieillissement survenu dans diverses conditions d'utilisation, tant permanentes que provisoires.

Le centrale électrique du Niagara 243
La puissante centrale électrique du Niagara, inaugurée la semaine dernière aux Etats-Unis, comporte une installation principale et une installation de réservoir de barrage. L'installation principale comprend 13 turbines hydrauliques utilisant une hauteur de chute de 96 mètres et entraînant des alternateurs de 150 MW Les transformateurs de générateur équipant cette centrale ont été construits en Grande-Bretagne. L'installation du réservoir de barrage comprend 12 turbo-pompes utilisant une hauteur de chute de 18 à 30 mètres. Elles sont accouplées à des moteurs-alternateurs de 20 MW. Cette installation permet d'utiliser pour la production de pointe le fort débit nocturne ou de morte saison dont l'usage est autorisé dans le cadre du traité international.

Circuits ouverts dans les moteurs à courant triphasé 259
Si une faute affectant une seule phase se produit dans un moteur à courant triphasé—avec ou sans accompagnement de perte à la terre cela peut affecter le rendement du moteur de diverses manières, selon la nature de la faute. On étudie ici toutes les combinaisons possibles de moteurs montés en étoile ou en triangle du point de vue de leur fonctionnement et de la façon dont elles affectent le rendement du moteur.

In dieser Nummer

Die Lebensdauer von Isolierungen 239
Isolationsmaterialien in elektrischen Maschinen verschlechtern sich im Laufe der Zeit unter dem Einfluss von Wärme und der mechanischen Beanspruchung, die durch Ausdehnung und Zusammenziehung der einschliessenden und eingeschlossenen Metallkomponenten auf sie ausgeübt werden. Zahlreiche Forschungsarbeiter haben sich seit über 50 Jahren mit diesem Problem befasst, konnten jedoch nur teilweise Lösungen hinsichtlich der Abschätzung der bei gegebenen Bedingungen wahrscheinlichen Lebensdauer erzielen; immerhin sind die bisher gewonnenen Erkenntnisse bei der Abschätzung der Alterung unter verschiedenartigen Voraussetzungen von Wert, und zwar in bezug auf Dauerzustände als auch auf vorübergehende Zustände von Maschinen.

Das Niagara-Krafterzeugungsprojekt 243
Das ausgedehnte Niagara-Krafterzeigungsschema wurde letzte Woche in den Vereinigten Staaten eröffnet und umfasst ein Hauptkraftwerk sowie mit gepumpter Speicherung arbeitende Kraftwerke. Das Hauptkraftwerk umfasst dreizehn Wasserkraftturbinen, die mit einer Säule von 96 m arbeiten und 150 MW Alternatoren betreiben. Die 180 MVA Transformatoren für dieses Kraftwerk wurden in Grossbritannien hergestellt. Die mit gepumpter Speicherung arbeitende Anlage hat zwölf Pumpenturbinen, die mit einer Säule von 18 bis 30 m arbeiten. Letztere sind an 20 MW Motorgeneratoren gekuppelt. Die Anlage erlaubt die Ausnutzung der grossen ausserhalb der Saison und während der Nacht anfallenden Wassermengen, soweit sie kraft internationaler Verträge zulässig sind, zum Zweck der Stromerzeugung für den Spitzenbedarf.

Unterbrochene Stromkreise in Drehstrommotoren ... 259
Fehler in einer der Phasen eines Drehstrommotors, die mit oder ohne Erdfehler auftauchen können, beeinträchtigen die Leistung des Motors auf verschiedene Weise, je nach der Art des Fehlers. Alle möglichen Kombinationen von Sternoder Dreieckschaltungen werden vom betrieblichen Standpunkt und ebenso im Hinblick auf die Beeinträchtigung der Motorleistung einem eingehenden Studium unterzogen.

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ELECTRICAL TIMES

ESTABLISHED 1891

THURSDAY, 16 FEBRUARY, 1961

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T. W. WRIGHT

Comment

ORDER OUTLOOK

Despite all that has been heard about the difficulties of industry, one section at least seems in good heart; that supplying capital goods. The evidence tending to this conclusion that is discernible in the chairmen's reports summarised regularly in our columns, and in the reviews of manufacturing progress and orders that have been appearing recently, receives strong confirmation from the latest Federation of British Industries' report on its inquiries of managing directors of some 752 firms. Despite pessimism about the trend in business outlook, significantly more expect an increase in capital expenditure authorisations on machinery in the next 12 months than see themselves as reducing activity in this category. Further, to the small extent that replies were given to a question about the rate of new orders for capital goods, this is considered on the increase compared with the early autumn of 1960. These predictions align with the forecasts published by the Board of Trade recently, which suggested nearly 30% more capital investment on plant by manufacturing industry in 1961 compared with 1960; and nearly 10% in other industries and services. Such a situation bodes more favourably for the heavy and medium electrical industry than the prospect facing the domestic and entertainment field, and the recently announced massive opening up of the hospital building programme must hold good prospects as well. One strange difference between the two surveys mentioned occurs, however; it involves buildings. Expenditure on these is likely to be as much as 40% up, according to the Board of Trade; with all that means for electrical installation equipment sales. In contrast, respondents to the FBI inquiry show a definite trend to allocating less to building work in 1961 than in 1960. Perhaps this denotes some falling back in years still further ahead. If so, it is a warning sign that should be more closely analysed.

TRANSATLANTIC TROUBLES

The troubles of the American heavy electrical manufacturing industry with the US anti-trust legislation have made headlines in the daily press during the past week; and have brought a reminder of the sharp difference existing between practice in the two countries. The newer restrictive practice legislation in this country works through registration of trade agreements, with court rulings on their standing "in the public interest" when they are put forward by an independent official. In the US there is an approach through general proscription of certain sorts of agreement, with provision for both criminal and civil legal

proceedings when transgression is alleged. Exercise of these rules seems to have been slack in the US for some time, and it is only recently that a number of moves have been made, particularly against the electrical industry, with the resulting sentences of imprisonment on leading personalities in the industry, and heavy fines on both individuals and companies. But the trouble in America is not ending there. Written into the American legislation is something unparalleled by British restrictive practices law, the right, already touched on, for customers to sue firms for the extra price that restrictive practices may have led them to pay for equipment supplied. There is a lot of litigation ahead on this count, and some very heavy payments to be faced by electrical firms if all decisions go against them, although how the extra cost to be attributed to illegal practices is to be calculated is hard to see. The current attempt by American industry to obtain an out-of-court settlement is understandable. What remains of interest well outside the USA is the effect the enormous financial drain potentially involved may have on the progress of the industry in the immediate future.

DANGER OVERHEAD

Once more this week, we have to record heavy awards of damages arising from accidents in which crane jibs have come into contact with overhead supply lines. The court actions concerned are the reflection of accidents in the past; while litigation proceeds, the danger continues. It seems difficult to get those on civil engineering sites to take seriously the danger that is ever-present when overhead lines are anywhere near, and serious accidents run steadily at a rate of about 15 a year, with a disturbing proportion of fatalities. Such a situation underlines the need for bringing into operation as soon as possible the specific requirements written into the draft Construction (General Provisions) Regulations, to be made under the Factories Acts, which are now the subject of discussion between industry and the Ministry. The regulations demand that something be done under the well-tried umbrella of "all practical precautions shall be taken to prevent such danger," and they put the onus firmly on the contractors, with an incidental reference to barriers as possibly the right sort of precaution. In this connection, the general recommendation of the Factory Inspectorate is, of course, worthy of note. It is for a fence parallel to a power line, at sufficient distance to ensure that the crane jib cannot contact the line. When the crane has to pass under the line, the great danger is that the jib will suddenly spring upwards for various reasons, such as unexpected release of load. To deal with this, it is deemed advisable to go to the complication of a goal-post type guard, which can give positive protection. Electricity board engineers ought to familiarise themselves with the details of these recommendations, for their advice is likely to be in demand on this subject; and perhaps more likely to be taken than in the past.

CRANE SPEED COMPLEXITY

It is the cluster of cranes that first impresses on a distant view of some docks; and it was cranes and their electrical complications which attracted most attention in the discussion of last week's IEE paper on the electrical requirements of cargo docks. Amongst the most perplexing problems confronting electrical engineers in this field is that of obtaining the necessary variable-speed drives for cranes, while maintaining the manifold advantages of a.c. distribution in all parts of the docks. The table in which the author lists 11 crane control schemes, all attempts to give variable speeds with the accurate adjustment desirable in this application, is eloquent of the magnitude of the problem. The first cost range is no less than 4·9 : 1 over the full 11, and the list of "disadvantages" includes, too frequently for comfort, a note about potentially heavy maintenance requirements. Such a circumstance makes it understandable that docks operators should hanker after d.c. and see salvation in recent developments in rectifier design. At its simplest, this might give a sufficiently high efficiency to make direct voltage divider control of a d.c. motor practicable. In its controllable form, the silicon rectifier may take matters a stage further by removing many of the objections to the use of a.c., through offering compact control of straightforward a.c. motors with the accuracy and flexibility that is so much desired.

CONTRACTING COMPLEXITIES

For the second time in recent weeks, one of our articles deals with the minor troubles of electrical contracting; with the accidents that can sap the profit on the small job and the iniquities of manufacturers and designers as seen from the craftsman's standpoint. This week's article, like its predecessor, probably says nothing entirely new. Indeed, its importance lies in the voicing of complaints that—accompanied by less polished language—are the commonplace of contractor's office and site stores alike. Many of the incidents described could only be avoided by careful selection and training of staff and by good quality supervision, but there are others which deserve the attention of manufacturers of fittings and accessories. Amongst the most common complaints against these essential providers of the contracting industry is their parsimonious attitude to wiring space. Criticism is, of course, too easy; no doubt a spell in the design office would whittle down the more extreme demands of some wiremen. On the other hand, a spell of wiring work would hardly fail to convince some designers that they ask too much of digital dexterity. In fairness, it must be said that an increasing amount of attention has been given to such questions by the more enlightened manufacturers. The need now is for the receptiveness to suggestions they show to become more widespread.

Meteor

This week's summary of electrical news faces advertisement page 20

Insulation longevity

ASSESSMENT OF LIFE IN ELECTRICAL MACHINES

by B. M. Weedy, B.Sc.(Eng.), Ph.D., A.M.I.E.E.*

THE problem of temperature rise in electrical machines is of paramount importance today, especially in large turbo-alternators and in machines in aircraft operating at high altitudes. Complementary to the problem of the assessment of temperature is that of the prediction of the probable life of the insulation surrounding the conductors which, from the point of view of machine failure, represents a major factor.

The consequences of raising the temperature in electrical machinery above a given level are as follows:

1. The differential expansion between the insulation, the surrounding steel, and the conductor, sets up mechanical stresses and subsequent abrasion of the insulation. The differential expansion is due to the different values of the temperature coefficient of expansion for the materials.

2. Changes in the electrical properties of the insulation, especially in the dielectric-loss factor (tan δ), may occur.

3. Changes in mechanical properties occur.

4. Chemical changes in the insulation occur which usually change the electrical properties.

One aspect of (1) above is known as "copper shortening" and this has been investigated by Juhlin[1] and Reay.[2] The present article is concerned mainly with the deterioration of insulation due to items (2), (3) and (4).

Some of the first work on the effect of temperature on insulating materials was carried out by Rayner[3] and published in 1905, while the present state of knowledge has been summarised in "The Symposium on Temperature Stability of Electrical Insulating Materials," published by the American Society for Testing Materials in 1954. Work by Montsinger[4] gives a law relating insulation life and temperature of the form $L=Ae^{-m\theta'}$, where L is the insulation life, θ' the temperature and A and m are constants, depending on the type of insulation. This law gives the well-known "rule of thumb" method for assessing insulation life when it is considered to be a function of time and temperature, i.e., thermal life is halved for each 10°C rise in temperature and doubled for each 10°C fall relative to the specified maximum. These values hold for Class B insulation, for Class A the corresponding figure is 8°C and for Class H, 12°C.

Work by Moses[5] dealing mainly with insulation failure in electric motors gives a law relating insulation life and temperature, also of the form $L=Ae^{-m\theta'}$. In particular, Moses gives upper and lower life-time relationships for the main classes of insulation. For Class B the expected life is stated to be within the following rather wide limits:

$$L = 106{,}000\ e^{-0{\cdot}0681\theta'}$$
$$L = 26{,}559\ e^{-0{\cdot}0665\theta'}$$

where L is in years and θ' is in °C.

* Department of Engineering, Southampton University.

Nature of the Temperature Rises in Electrical Machines

The various classes of insulation material used in electrical machinery and their assigned operating temperatures are given in the British Standard 2757:1956. The assessment of the hot-spot temperature in a winding is often very difficult due to the practical difficulties in installing thermocouples close to the actual copper. Often only the mean temperature as given by the "change of resistance method" is available. Nevertheless, investigations have shown that the rise in temperature at a hot-spot when a step-function of current is switched on, is either of the form $\theta=\theta_m(1-e^{-t/\tau})$ or $\theta=\theta_1(1-e^{-t/\tau_1})+\theta_2(1-e^{-t/\tau_2})$, where τ, τ_1 and τ_2 are thermal time-constants. For an indirectly cooled turbo-alternator rotor (cooled by hydrogen) it has been shown[6] that the hottest portion of the conductors follows a single expotential law, i.e. $\theta=\theta_m(1-e^{-t/\tau})$ with a step function of excitation current applied. For a sudden short-circuit in a winding the temperature rise-time relationship can be considered to be linear during the duration of the fault. In the following analysis, the single exponential type of temperature rise-time equation will be assumed as this represents a simple but practical condition.

Evaluation of Cumulative Damage to Insulation

In this analysis the following nomenclature will be used:

D—a dimensionless quantity by means of which cumulative damage to insulation is assessed.

L—life of insulation in hours.

θ'_0 and t_0—temperature and time at the commencement of the assessment of damage (°C and hours).

θ'_t and t_t—temperature and time up to which damage is assessed (°C and hours).

θ'_m—maximum steady-state temperature (°C).

θ'—temperature at any time t (°C).

$1/\alpha$—time constant of transient (hours).

A and m—constants depending on type of insulation.

If the rate of damage accumulation is considered to be a function of temperature only, then

$$\frac{dD}{dt} = f(\theta') = \frac{1}{L}$$

Failure finally occurs when

$D = 1 = \sum \Delta D$ i.e. the sum of the increments of damage resulting from steady state and transient conditions.

The increment of damage ΔD for each operating period from time t_0 to $t_t = \int_{t_0}^{t_t} \left(\frac{1}{L}\right) dt$

If the temperature is constant:

$\Delta D = \Delta t/L$, where Δt is a discrete time interval. As previously stated it is assumed that the rise in the

temperature of the hot spot of a machine winding when current is suddenly switched on, is of the form:

$$\theta = \theta_m (1 - e^{-\alpha t})$$

where $\alpha = 1/\pi$ and θ, θ_m are the temperature rises at time t and at steady state respectively.

It should be noted that it is the hot-spot temperature which is of vital importance and not the average winding temperature, as it is at the hot-spot that insulation failure will initially occur.

From the temperature rise equation:

$$\frac{d\theta}{dt} = \alpha \theta_m e^{-\alpha t}$$

$$= \alpha \theta_m \left(1 - \frac{\theta}{\theta_m}\right) = \alpha (\theta_m - \theta)$$

If actual temperatures are used instead of rises,

$$\frac{d\theta'}{dt} = \alpha (\theta'_m - \theta')$$

assuming that the coolant temperature is constant. The damage increment between times t_0 and t_f

$$= \Delta D = \int_{t_0}^{t_f} \frac{1}{L} dt$$

$$= \int_{\theta'_0}^{\theta'_f} \frac{1}{L} \frac{d\theta'}{\alpha (\theta_m' - \theta')}$$

Insulation life L, if considered a function of temperature only, is governed by the law $L = Ae^{-m\theta'}$.
Hence

$$\Delta D = \frac{1}{\alpha} \int_{\theta'_0}^{\theta'_f} \frac{d\theta'}{Ae^{-m\theta'} (\theta'_m - \theta')}$$

The solution of this integral is

$$\Delta D = \frac{e^{\theta' m} m}{\alpha A} [(-Ei(-x_f)) - (-Ei(-x_0))]$$

where $x = m(\theta'_m - \theta')$ and $-Ei(-x) = \int_x^\infty \frac{e^{-y}}{y} dy$;

$$x_f = (\theta'_m - \theta'_f) \; ; \; x_0 = (\theta'_m - \theta'_0).$$

Values of the exponential function $-Ei(-x)$ are available in mathematical tables.

This method of prediction of insulation damage has been used by Robinson[7] in work on blast-cooled aircraft generators, and has recently been applied by Ben Uri[8] to the ageing of transformer insulation.

Application of the Method

As an example of the application of the technique, an indirectly cooled turbo-alternator rotor, i.e., one in which the cooling gas is not in direct contact with the copper conductors, will be considered. It has been shown[6] for a particular rotor that the law relating the temperature rise of the hottest section of conductor with time when the rotor current is switched from zero to the rated full load value is:

$$\theta = \theta_m (1 - e^{-3t})$$

The coolant is assumed to be of uniform temperature at the section considered, the rotor being initially at 25°C and finally, i.e., at steady state, at 119°C. The insulation surrounding the conductors is designated as being Class B.

Consider the increment of damage or insulation deterioration taking place in the first hour of the resulting temperature transient.

$\theta'_m = 119$°C; at t = 1 hour, $\theta' = 114$°C; $\alpha = 3$

Using the lower life-limit relation given by Moses for Class B insulation:

$$x_f = 0{\cdot}0665 (119 - 114) = 0{\cdot}3325$$
$$x_0 = 0{\cdot}0665 (119 - 25) = 6{\cdot}25$$

From the appropriate mathematical tables

$$-E_i(-x_f) = 0{\cdot}83$$
$$-E_i(-x_0) = 0{\cdot}0002705$$

$$\therefore \Delta D = \frac{e^{(0{\cdot}0665 \times 119)}}{3 \times 26{,}559 \times 365 \times 24} (0{\cdot}3325 - 0{\cdot}0002705)$$

$$= 0{\cdot}0386 \times 10^{-4} \times 0{\cdot}3322295$$

$$= 1{\cdot}28 \times 10^{-6}$$

i.e. the damage increment from t = 0 to t = 1 hour of the transient is $1{\cdot}286 \times 10^{-6}$. Damage occurs when $\Sigma \Delta D = 1$.

The corresponding damage increment incurred with steady-state operation at 119 °C over an hour is:

$$\Delta D = \frac{1}{26559e^{-0{\cdot}0665 \times 119} \times 365 \times 24}$$

$$= 11{\cdot}4 \times 10^{-6}$$

The life of the insulation, if this hot-spot is maintained continuously at 119°C and the "Moses" lower temperature-insulation life relation used is ten years when $\Delta D = 1$.

If the rotor current be increased to 10% overload, the steady-state temperature is 134°C and $\Delta D = 6{\cdot}02 \times 10^{-6}$ over the first hour of the transient. The corresponding value of ΔD if the steady-state condition is maintained for one hour is 28×10^{-6}. The effects of overloading the winding from the point of view of long-term insulation failure are thus obvious.

Deterioration during Periods of Cooling

Similar reasoning may be applied under this condition as is applied above for heating. The temperature fall-time equation is of the form $\theta = \theta_m e^{-\alpha_1 t}$

from which $$\frac{d\theta}{dt} = -\alpha_1 \theta_m e^{-\alpha_1 t}$$

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and $$\frac{d\theta'}{dt} = -\alpha_1 (\theta'_m - \theta')$$

Hence $$\Delta D = -\frac{1}{\alpha}\int_{\theta'_0}^{\theta'_f} \frac{d\theta'}{Ae^{-m\theta'}(\theta'_m - \theta')}$$

$$= \frac{1}{\alpha}\int_{\theta'_f}^{\theta'_0} \frac{d\theta'}{Ae^{-m\theta'}(\theta'_m - \theta')}$$

It should be noted here that $\theta'_0 > \theta'_f$.

The damage increment incurred during the period of cooling is therefore of comparable importance to that during the period of heating.

Conclusions

The above work depends largely for its practical value on the temperature-insulation life relationship assumed for the insulation under investigation. Detailed work on the many varieties of insulation used in machines is sparse and the life-time relationships published by Moses needs corroboration. In this particular field much work needs to be done.

The results obtained above show clearly, however, the relative rates of insulation ageing for different machine conditions, both steady-state and transient, and the method can be readily extended to a given daily load cycle.

Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Safe Terminations for H.V. Motors

CONSIDERABLE attention has been directed to the cable terminations to high voltage motors by recent unfortunate incidents. All associated cable end boxes may be subjected to similar internal pressures in fault conditions, but the connections to motors have particular features that call for special treatment. They can present a greater hazard to personnel because of their location.

They are usually designed in relation to the motor ratings instead of prospective fault power, which may necessitate cables of increased cross section. Also, the likelihood of condensation in motor terminal boxes is greater than in those of static equipments. Creepage and clearance distances where the tails emerge into the terminal boxes are not given sufficient attention, and sufficient room between the cable box and the terminals of the motor to facilitate the connection of the tails is not always provided.

Connections to motors have to be disturbed more frequently than with other equipments for maintenance and other reasons; the design of motor terminals should allow for connection and disconnection without strain on the cable tails.

It is the writer's opinion that the terminal boxes and cable end boxes should be adequate for the fault power available, and that the connections between them should be via through-insulators designed to exclude moisture from the cable box.

No attempt should be made to confine the explosive forces consequent on a short-circuit within a cable box, but the front half and its clamping bolts should be strengthened and provision made to relieve pressure in the side facing the motor.

Cymnotus.

Installing and Jointing Solidal Cables

I WAS very interested in your article on the installation and jointing of Solidal cables in your issue of 26 January. There are however one or two points which I would like to bring to other readers' attention.

On page 125 mention is made of passing current through the cable to warm it up prior to laying in cold weather. I suggest this should be undertaken with extreme caution as the inner flakes on a large drum load can become overheated very easily without any indication on the outer flakes.

With regard to the statement on page 126 that a joint will not fail through moisture entering a pin hole, my own experience is that if the conductors are not hermetically sealed at the joint, moisture entering the box can cause a leakage path between phase and neutral, or between phases if two pin holes are present.

The jointing of the concentric neutral (page 128) would appear unnecessarily involved, as there is a simple device on the market by means of which armour wires or the strands of a concentric neutral are held in intimate contact between a tension strap and a compression ring. This device has been used for armour bonding for several years and can be used for concentric conductor jointing by merely substituting a non-magnetic compression ring for the normal steel ring.

I notice that mention is made only of cast iron or plastic boxes, whereas all area boards have been using stoneware protection boxes for the past ten years or so and a range of miniature sizes is available for use with plastic cables.

J. K. Maynard, D.F.H., A.M.I.E.E.,
DEVELOPMENT ENGINEER,
THE HEPWORTH IRON CO. LTD.,
KINGSTON UPON THAMES, SURREY.

* * *

THE observations made by Mr J. K. Maynard on the article in your 26 January issue on "Solid Aluminium Cables" are technically sound, but call for some additional comment by way of elaboration.

We fully support the caution advocated by Mr Maynard in the warming of cables on drums by passing currents through the cores. The outer cable flakes on the drum will certainly give a thermal blanketing effect, and if care is not exercised there is a possibility that the inner flakes will get too hot and the weight of the outer flakes may cause some distortion of the p.v.c. insulation and sheath. It is necessary, therefore, carefully to control the amplitude of current and time of application to ensure that the inner coils do not reach an excessively high temperature. Naturally, a far better solution to the problems associated with the installation of plastic cables at sub-zero temperatures is to keep the cables in a relatively warm store for a period before laying.

With regard to the question of moisture entering a joint in a p.v.c. cable through pin holes, leakage between phase and neutral can be effectively prevented if the generally accepted practice is adopted of wrapping the core joints with a water-impermeable tape before the application of the joint resealing compound. Suitable tapes for this pur-

pose in the form of non-adhesive self-bonding plasticised p.v.c. film are readily available on the market. Fig. 6 in the article gives a clear illustration of a taped core joint.

On the jointing of the concentric neutral, we should like to emphasise that the greatest importance should be attached to the design of such joints to ensure that they give guaranteed electrical stability in service. Whilst we are not criticising the design of the accessory referred to by Mr Maynard, we would suggest that, although these fittings may have given satisfactory service for a number of years for the bonding of steel armour, they would have to be rigorously tested before they could be accepted for the jointing of concentric neutrals. If Mr Maynard has evidence to prove the electrical stability of such fittings we should be most pleased to have it.

L. Roullier,
HEAD OF THE ELECTRICAL DIVISION,
ALUMINIUM LABORATORIES LTD.

Theme in Lighting Design

IT was most interesting to read the philosophy in Home Lighting set out in the article in your 2 February issue, and commendable to see the word "glare-free" so frequently mentioned, particularly after approximately two million of the bare lamp fittings have been produced by this one manufacturer alone.

I should like to put forward the following points which come to mind.

I have kept a close watch on the domestic lighting trend for many years, and it is only in the last few years that the *average* home-lover has become really light conscious. This has been confirmed by the increase in friendly inquiries which I have received to advise on home lighting. The usual query is that the home-lover feels something is missing in his lighting, and asks "Can you come and give me some advice on how to improve my lighting?" The pattern is fairly consistent; the central positioning of ceiling lights, the Mk I addition of perhaps two wall brackets and Mk IA the standard lamp.

By far the most common place where fluorescent lighting has been installed in the home is the kitchen, usually because the original lighting point is centrally disposed and the householder is in difficulty at the sink and similar positions. The erection of an 80 W fluorescent lamp may not completely cure the problem, but it will at least be a good face-lift. Now what happens regarding choice? And I speak from experience. "Have you any *cheap* lighting fittings suitable for fixing in my kitchen?" "Could I see some catalogues please?" The battle is now on to convince the householder for his own good to pay that wee bit extra and have a fitting with an opal diffuser screen or cover, rather than the lowest cost bare lamp batten or kitchen light with tungsten ballast.

I fitted up two 80 W fluorescent batten type fittings, one with and one without an 040 Opal diffuser. I have considerably reduced the strain on my vocal chords, and the householders have now been purchasing a better class of lighting for kitchens.

I note with pleasure that there are no bare lamp fittings illustrated in Mr P. T. Rodd's article.

It must be appreciated that the levels of illumination in domestic premises are very low indeed, often not more than 6 lumens/sq ft, and much less under active working areas. The 80 W and 40 W fluorescent lamps will have very high levels which can be 150 lumens/sq ft.

D. Clark,
NORWICH.

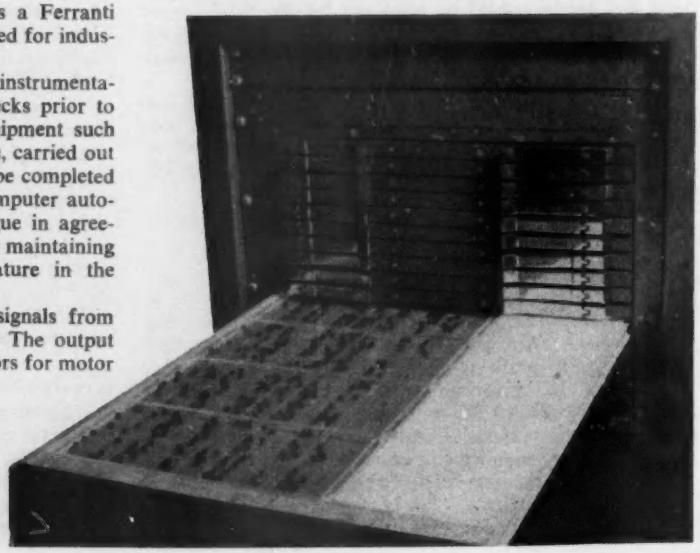
Computer to control 200 MW set boiler

A COMPUTER will be installed at the West Thurrock generating station of the CEGB to control boiler operation, including start-up and shut-down. The boiler is one of two 1,400 klb/hr units which will supply 200 MW sets.

On Tuesday, it was announced that the boiler makers, Babcock and Wilcox, had placed an order for the computer with Ferranti. The computer will be similar to one ordered concurrently for an ICI chemical plant. It is a Ferranti Argus special-purpose machine which is intended for industrial process control applications.

Operating in conjunction with conventional instrumentation, the computer will make preliminary checks prior to starting-up and will then start individual equipment such as fans and pulverisers. The start-up procedure, carried out in conjunction with analogue controllers, will be completed as quickly as possible. During start-up the computer automatically adjusts the set-points on the analogue in agreement with actual plant measurements while maintaining all such limits as maximum metal temperature in the superheaters.

The equipment can accept 171 analogue signals from 97 transmitters and 32 three-term controllers. The output can provide digital drives to about 150 contactors for motor and actuator control. One printer will give continuous information on computer operation and plant behaviour and a second will print out at regular intervals, boiler temperature, pressure, calculated efficiency and other parameters. A valuable feature will be the computer's ability to give consistent performance and to make repeated checks on alarm and operating points, so safeguarding against the occurrence of dangerous conditions.



The peg-board construction used for the Ferranti Argus programming trays, one of the features of this computer which will control a 1,400 klb/hr boiler at West Thurrock Power Station

U.S. taps Niagara power

ACROSS the Niagara river and about four miles below the world-renowned Falls, two large hydro-electric projects now face one another. On the Canadian bank are the two Sir Adam-Beck stations, while on the American side the vast Niagara Project of the Power Authority of New York State has come into action. Last Friday, Governor Rockefeller, of New York, inaugurated the project by switching on the first of the 25 generator units which will eventually have a firm generating capacity of 1,800 MW and an installed rating of 2,190 MW, including a 240 MW pumped storage scheme.

The American scheme has much in common with its forerunner on the Canadian bank. Both schemes include pumped-storage facilities enabling them to make full use of the permissible water flow conditions of the 1950 Canadian-American treaty. Both stations take their water from the river well upstream of the Falls.

The treaty stipulated that, in daylight hours during the tourist season, at least 100,000 cu ft of water must flow over the Falls every second ensuring that their natural beauty remained unimpaired. But it also allowed the flow to be cut to 50,000 cu ft/sec at other times.

During the hours of darkness and other periods of low demand, water not required for generation will be available for pumping to a storage reservoir for release during subsequent times of peak demand. In addition, the project will be linked by a 250-mile long 345 kV transmission line to the Robert Moses Dam on the St. Lawrence river and power will be economically available from this dam to assist pumped storage operation.

Power Increased

By constructing the water inlets nearly three miles upstream of the Falls the effective head, which at the Falls is only 165 ft, is raised to 314 ft, enough to nearly double the output of a similar plant located at the site of the Falls. The additional head is made possible by siting the station inlets above the cataracts at the top of the Falls and the tailrace after the rapids below the Falls.

However, the American scheme is not only a hydro-electric project. It also includes an extensive programme to improve the appearance of the district overlooking the Falls. For the visitor, the Niagara Parkway under construction will enable him to obtain an uninterrupted view across the Falls and the River. It will run from the Grand Island Bridge about four miles above the Falls alongside the river and gorge to the town of Lewiston downstream of the generating station. Here a new International bridge is under construction and this will also link with the Grand Island Bridge by an expressway by-passing the city of Niagara Falls. Other projects include a new visitors' observation building overlooking the gorge, relocation of rail tracks away from the river bank and planting of park areas.

Although the Niagara river is only 34 miles long, it drains a vast tract containing four of the five Great Lakes and with an area of 265,000 sq miles. The river flows

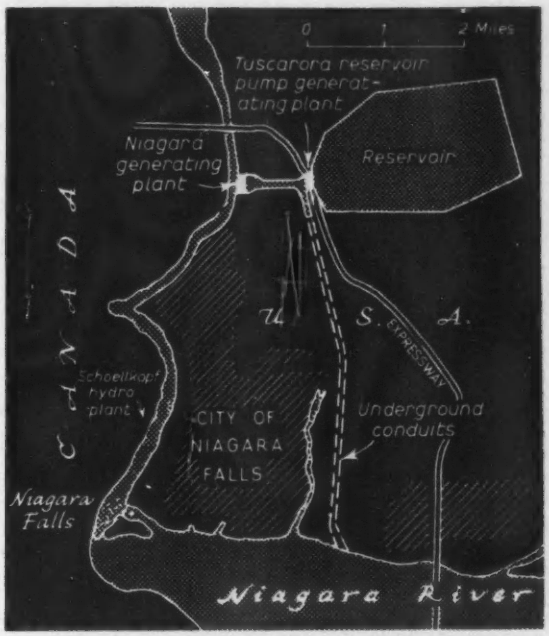


Fig. 1. Combined installed capacity of the Niagara hydro-electric and Tuscarora pumped storage stations will be 2,190 MW when they are completed in 1963. Here the site of the station and culverts are shown with the expressway and bridge over the lower Niagara River, now under construction

between Lakes Erie and Ontario and forms the boundary between Canada and USA. Its flow depends on the height of the water in Lake Erie and although it is also slightly affected by wind intensity, an average flow of 202,000 cu ft/sec is maintained. It is particularly suitable for hydro-electric generation since the ratio of maximum to minimum flow is little more than two, contrasting very favourably with, for example, the Columbia River's ratio of 35:1.

The need for more generation in New York State became urgent when two-thirds of the existing 335 MW Schoellkopf station at Niagara was destroyed by a rock-fall in 1956. Since then, high-priced power, including substantial purchases from Canadian sources, has been needed to keep local industry going. Because of the urgency for new generating plant in the Niagara district, construction on an accelerated schedule was pushed ahead as soon as the development license was granted in January, 1958. The project is estimated to cost $720 million when it is completed and the planned installed capacity of the two stations of 2,190 MW is claimed to be the largest for a hydro-electric station in the Western World.

Waterways

The upper Niagara river flows from east to west and the two water intakes are sited about 2½ miles above the Falls. Two culverts, nearly four miles long, carry the water to the north, under the City of Niagara, to an L-shaped canal having at its western end the intakes for the main generating plant and at the eastern end the pumped storage station tailrace.

The two concrete intakes, aptly described as "Harmonica" type, lie along the river bank below water level, they are each 700 ft long with 48 slotted openings varying from 13 ft to 26 ft below the river surface and equipped with guide vanes. To ensure adequate flow from the river, the bed has been dredged to a funnel shape over an area of nearly ½ sq mile. The intake structures were

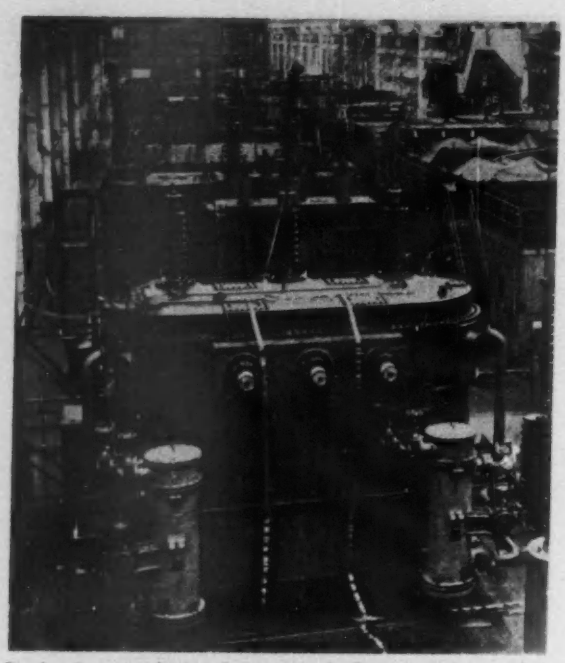


Fig. 2. Preparing for impulse tests at the Ferranti works one of the 180 MVA, 13·2/120 kV generator transformers

constructed behind a coffer dam extending 1,200 ft into the river. To direct water into the intakes, a 2,000 ft long rock-fill dike is also under construction from a point opposite the intakes on Buckhorn Island. The only visible part of the intakes will be a concrete apron wall and the two structures housing the 49 ft by 68 ft high gates for isolating the culverts.

The two culverts, constructed by the cut and cover method, are 46 ft wide and 66 ft high. They are designed for a combined flow of 83,000 cu ft/sec at a velocity of 14 ft/sec. The walls and floors of the conduits have a minimum thickness of 2½ ft and they average 40 ft below ground level. Pumping stations at the ends of the conduits can be used to empty one conduit, through a sump, into the other for inspection and repair.

At the generating station, the conduits merge into an open canal forming the short leg of the L-shaped forebay. The forebay is 3,000 ft long and 500 ft wide. The canal linking the forebay to the conduits is unlined and, as it is open, it can act as a surge basin if an emergency shut down of the main plant is necessary.

Generating Station

During construction of the Niagara station more than seven million cubic yards of rock was removed from the river gorge. At the end of the forebay is the intake structure of reinforced concrete, 1,100 ft long and over 100 ft in height from the foundations. There are 13 intakes in the gravity type structure, each equipped with trash racks, emergency stop-log slots and vertically lifting gates. A 90-ton crane handles the gates and racks.

Water flows from the intake structure down through 13 welded steel penstocks, 462 ft long to the powerhouse below. The penstocks have reducing elbows at the top and bottom and these are encased in concrete. The top elbow reduces the inflow channel diameter from 28½ ft to the penstock diameter of 24 ft. At the lower end, the diameter is further reduced by the elbow to the turbine scroll entry diameter of 21 ft. On the gorge side of the intake structure will be constructed the Lewiston Road and also the new Parkway totalling 140 ft in width.

The powerhouse is 1,840 ft long and 98 ft overall height it is notable for the semi-outdoor construction used with the generators mounted beneath movable hatches. Between the penstocks and the generator structure are the control tunnels and transformer bays.

Generating Plant

The 13 generators are driven by 200,000 h.p. Francis turbines built by Baldwin Lima Hamilton. Each turbine has a runner diameter of 205 in. and rotating parts weighing 198 tons. The generators are rated 150 MW at 13·2 kV 60 c/s. They are of Westinghouse manufacture, designed to rotate at 120 r.p.m. Each generator rotor is 408 in. diameter and the total weight of rotating parts is 669 tons. The stator coils alone weigh 235 tons. For initial assembly and maintenance a 630-ton travelling crane runs above the generator hatch covers. At the south end of the power station is the station control room, offices and erection bay. The gantry crane can enter this bay with the generator components and a further overhead crane is provided. Generators are linked to transformers by isolated phase buses. The 13 generator transformers are split into groups of 6 and 7 with ratios of 13·2/120 kV and

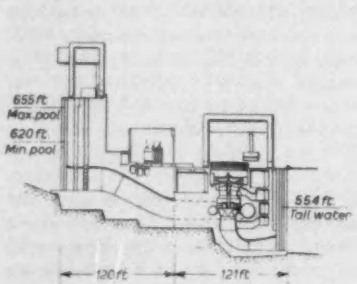


Fig. 3. Cross-section of the Tuscarora pumped storage station. The plant will have 12 pump/turbines operating under a head of 60-107 ft. The storage pool is to the left and the canal from the twin underground conduits enters the forebay in front of the station tail face

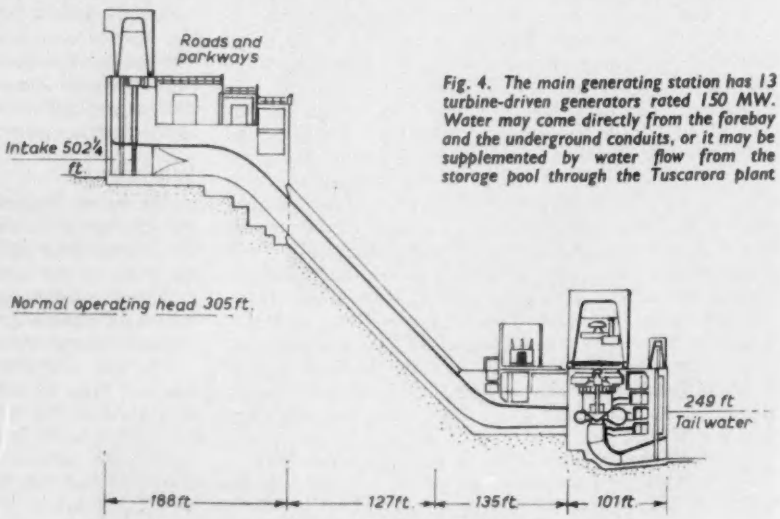


Fig. 4. The main generating station has 13 turbine-driven generators rated 150 MW. Water may come directly from the forebay and the underground conduits, or it may be supplemented by water flow from the storage pool through the Tuscarora plant

13·2/240 kV. The contract for the transformers, valued at nearly $4 million, was won by Ferranti. The transformers are OFWF cooled, with dry nitrogen gas above the oil space. The windings are graded for a solidly earthed system and incorporate directed oil flow. Tests under the supervision of Merz and McLellan included impulsing at 825 kV on the 240 kV windings. Each of the high voltage units weighs 175 tons.

Switchyard

From the transformers, power is taken to the three-section switchyard, on the south side of the forebay above the station, by 13 oil-filled cables operating at 115 kV and 230 kV. A further four cables bring in power at 230 kV from the pumped storage station.

The 115 kV section of the switchyard contains 78 disconnecting switches and 33 oil circuit-breakers each rated 10,000 MVA. The 230 kV yard has 48 disconnecting switches and 26 oil circuit-breakers with a short-circuit rating of 20,000 MVA.

Tying the 115 kV and 230 kV sections are two 200 MVA auto transformers, while a further two transformers, rated 400 MVA, link the 230 kV yard with the outgoing 345 kV section. This section, which will have three outgoing circuits to Rochester, has 15 disconnecting switches and four oil circuit-breakers designed for a 25,000 MVA interrupting capacity.

Tuscarora Pumped Storage Plant

At the eastern end of the forebay, a reservoir is under construction above ground level which will have a storage capacity of 60,000 acre ft. Into this reservoir will be pumped water from the culverts during the night for subsequent generation at times of peak load. The reservoir, built partly on an Indian reserve, will be bounded by a rock dike 55 ft high and 260 ft wide at its base. This dike, with a total length of nearly 6½ miles, is at present about 50% complete.

The dam for the reservoir is already under construction and when completed it will measure 974 ft long by 240 ft wide with a height of 160 ft. The upstream side of the dam is tied to the dike by concrete core walls. The 12 intakes will have trash racks, emergency stop logs and intake gates, served by a 65 ton gantry.

The penstocks linking the intake to the turbine scrolls have falls of 32 ft and are completely embedded in concrete. Their diameter varies from 18 to 24 ft.

The semi-outdoor construction is similar to that adopted for the main station with the turbine generators mounted below movable hatches, access being provided by a 150-ton gantry.

Each of the 12 turbines is of a modified Francis design, built by Allis-Chalmers, and rated 28,000 h.p., with a net head of 75 ft. When pumping they are designed to deliver 3,400 cfs against an 85 ft net head.

Single pump/turbine units are installed, coupled to motor/alternators capable of developing 37,500 h.p. as motors and generating at 20 MW, 13·2 kV 60 c/s. The generator transformers of the pumped storage station are 100 MVA units manufactured by Brown Boveri. The station is designed to operate with a head of 62-107 ft for pumping and 60-100 ft for generating.

Power Output

When the station is completed in 1962, the installed capacity will be 2,190 MW, or about 8% of the present generating capacity of the CEGB. The firm generating capacity, 1,800 MW will, it is estimated, provide an annual energy output of 13 billion kWh.

In the construction of the dam, what is claimed to be the largest aggregate plant ever built is in use. 10,400,000 tons of aggregate will be required to make the 3½ million cu yds of concrete and form the rock blankets for the dikes. For mixing the concrete, plants have been erected with automatic control for the proportions of materials.

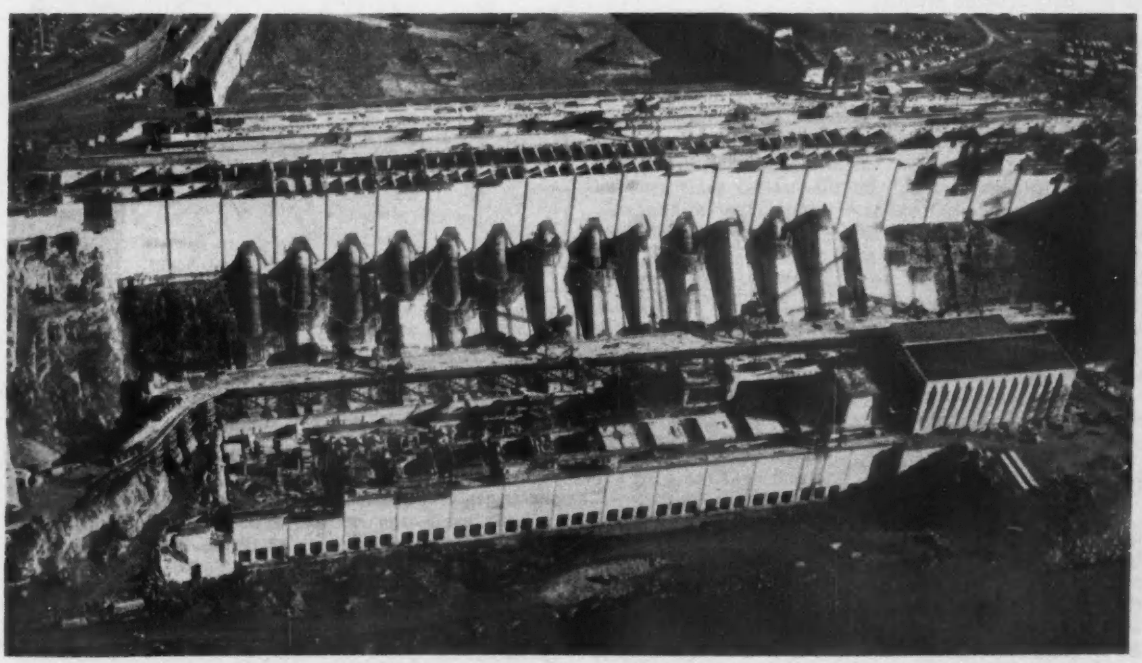


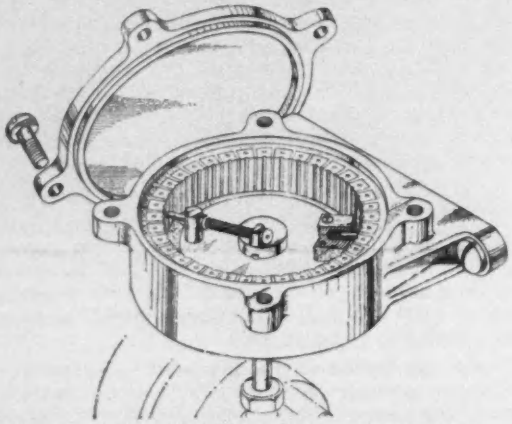
Fig. 5. Constructional view of the main station. At the top are the forebay and the main intake structure with the penstocks partially concreted. The partially completed turbine chambers and the alternator hatch covers are visible in the foreground with the machine erection bay on the right

PROGRESS IN PATENTS

SELECTED SPECIFICATIONS

Sequence Switch

Sequence switches are not by any means new. For the most part they comprise studs or commutator segments with a wiping contact and, sometimes, a precessing device to ensure positive location at each step. Where small currents are concerned, it is a requirement that contact resistance is substantially the same at each position and



A sequence switch of novel design for low resistance contact

that it remains consistent throughout the life of the device. This calls for careful design, assembly and, in many cases, special constructional features.

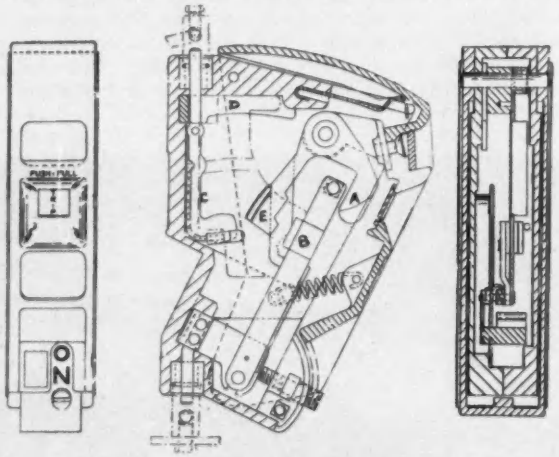
In the recently published specification 860,438, the Minister of Aviation describes a sequence switch of novel design to meet such conditions and intended primarily for motorised operation. As the diagram shows, this is of the internal commutator pattern, in which the moving contact is a rod mounted on a circular plate and serves the double purpose of carrying the current and precessing the device from step to step. A crank on the central shaft imparts a combined radial and oscillatory movement to the rod, the former being imparted through a compression spring at one end of the travel to hold the rod in contact with the segment and through an end collar at the opposite end of the throw when the rod is drawn clear of the segment prior to being transferred, by a "walking" action, to the next. Grooves in the segments assist in centring the rod at each position and also act as locators for the detent at the opposite end of the plate to ensure positive positioning. Flexible leads, not shown, provide the electrical path between terminal and contact rod.

Irradiated Cables

Interest in irradiated polymer insulation for cables is of comparatively recent date but ideas were developing as far back as 1957-58. A number of specifications recently published bear application dates early in 1958 and show that considerable progress in practical application had already been made. T.I. (Group Services) of Aston, Birmingham, are among those who have filed applications. One aspect of their studies has been to develop methods whereby comparatively low energy electrons, which have a limited penetration, can be applied to irradiation of cable coverings of practical thickness. In specification 860,811 the method adopted is to extrude a series of thin coatings in a continuous process with the cable or wire passing through irradiation chambers between each extrusion head. Using polythene as the polymer, it is claimed that a beam of only 250 KeV electrons has sufficient energy to irradiate 0·01 in. thickness and that there is adequate adhesion between consecutive layers for the production of homogeneous coverings.

Miniature Circuit-breaker

An interesting miniature circuit-breaker combining thermal and magnetic trips and suitable for close ganging is the subject of specification 860,784 in the name of Brian Hargreaves, of 2 Central Drive, Ulverston, Lancs. A moulded insulated base houses at its upper end a fixed contact, C, and an electromagnet, D, surrounding the incoming connection to the contact while, at the lower end, it provides the hinge and incoming connector of the moving contact, B. The latter is partly of bi-metal, flexing at right angles to the line of closing movement, and is provided at the upper end with a detent for engagement



Combined thermal and magnetic trips are a feature of this compact miniature breaker shown in the "open" position

with the cranked rocker, A, of insulating material hinged to the cover moulding, and on which is a magnetic plate, E. On heavy overloads the attraction of E by D lifts the rocker and allows the switch to open. On sustained overloads of lower order the deflection of the bi-metal strip disengages the detent and also releases the switch arm. In both cases, the opening movement of the arm, by striking the cranked portion of the rocker, introduces the opposing end as an arc barrier between the contacts. Resetting is by pulling forward the hinged cover to re-engage the detent, the same action also serving as manual opening for isolating.

Reproduced by permission of the Controller of H.M. Stationery Office. Copies of specifications may be obtained from the Patent Office (Sales Branch), 25 Southampton Bldgs, W.C.2. Price 3s 6d.

Electricity in cargo docks

DISTRIBUTION, CONTROL AND APPLICATION

SUPPLIES for cranes and for pumping equipment are the principal electrical requirements for docks handling ocean-going shipping. What this means from the electrical engineering aspect is discussed in a paper* presented to the Utilisation section of the IEE last week. The paper, necessarily discursive like its subject, is based on experience with the South Wales ports, but its author feels its application must be wider.

Private generating plant is not in general an economic proposition for docks, and a supply at 11 kV or 6·6kV is required from the public supply. Practice in South Wales is to accept energy from the appropriate electricity boards at published tariffs, distribute it through a system owned by the dock authority, and supply it to dock tenants again at area board published tariffs, relying on maximum demand diversity to give a financial working margin.

Distribution Design

Special features which must be noted in designing a dock electrical system are listed by the author as follows:

(a) The load factor is lower than continuously working process plant, but supply is required 24 hours per day for seven days per week.

(b) Certain parts of the system are vital.

(c) The types of load and load factor of tenants and dock machinery vary widely.

(d) Water crossings, sometimes preventing easy access to substations, will be met.

(e) There are intermittent but substantial demands at many places, necessitating a larger number of sub-stations per 1,000 yd than usual, giving a high ratio of transformer capacity to system maximum demand.

(f) Cables must be used for the h.v. supply, but l.v. overhead distribution may be a satisfactory economic solution for some areas of the estate.

The complication of numerous water crossings is a special feature of dock installations. These affect the choice of cables, and while single-wire-armoured and served types are used in general work, double-wire-armoured non-draining types with double servings are used for water crossings. For these crossings, either a culvert or a wall chase is provided at the time of building the dock, the former being better for installation and maintenance, but having the disadvantage of relatively high first cost. It is found advisable to provide special chases for the electrical services, to prevent cable damage and supply interruptions when other services are being repaired. In vertical chases, cables are cleated at 3 ft intervals, while they are dressed down into horizontal chases to avoid disturbance when water is flowing in and out of the docks. To avoid strain on joints, a clamping anchorage is necessary at each side of a water crossing, if neither culvert nor chase is provided.

Pumps

Pumps may be required in docks for general movement of water in connection with ship handling or to operate large hydraulic systems. An impounding pump, which is used to keep constant water level in a dock, runs for about six hours against a varying hydraulic head. Present

TABLE 1. Comparison of Crane Control Schemes

	Method	*Relative cost %*	*Principle*
1	Slip-ring motor with external resistance control	100 (=£900)	Variation of torque and speed by external resistance in rotor circuit.
2	D.C. injection braking	158	Hoisting as for (1). Braking obtained by injecting direct current into rotor.
3	Electro - mechanical	200	Low speeds obtained by partial application of an electro-mechanical brake automatically controlled by speed of motor.
4	Counter - current braking	148	Control of lowering by having motor polarity as for hoisting with external resistance in circuit.
5	Counter - current braking and relay control of rotor resistance	170	As (4) but with rotor resistance controlled by "fluttering" relays.
6	Counter - current-plus-relay control of rotor resistance plus pony motor	217	As (5) but using additional motor at 10-20% of hoist motor b.h.p.
7	Counter - current-plus-relay control of rotor resistance plus two hoist motors	217	As (4) but using two motors, one of 75% normal hoist motor b.h.p.
8	Opposed torque using braking unit directly coupled to driving motor	312	Squirrel-cage-motor electric braking unit with field energised by a variable d.c. supply direct coupled to the hoist motor giving opposed torques.
9	Opposed torque using two electrically separate windings in the same motor frame, forming braking and motoring units ...	432	By varying resistance of the motor system and the resistance and/or d.c. excitation of the brake system, the combination of opposing torques gives different torque / speed characteristics for each system, providing stable no-load speeds where they cross.
10	A.C. commutator motor	487	Speed control by moving of brushes.
11	Ward Leonard ...	305	A.C. motor driving d.c. generator.

*3365: "Some Notes on the Electrical Requirements of General Cargo Docks," by E. R. Radway, M.I.E.E. [Mr Radway is with British Transport Commission (South Wales Docks).]

practice is to use on-line started squirrel-cage motors for such drives, rated at about 700 h.p. at 3·3 or 6·6 kV and capable of running up to speed in about four seconds with starting currents of three to three and a half times full load. Motor protection is by means of thermal overload relays with phase failure, overload, short-circuit and earth-fault features. Direct switching uses vertical-isolation horizontal draw-out o.c.b's. These seem to work satisfactorily in terms of contact wear, but carbonisation may make it necessary to change oil after every 250 operations.

For hydraulic pressure pumping, there is a trend towards 2,950 r.p.m. motors, with the accent on using squirrel-cage machines where possible. Experience with these has been excellent, but the frequent starting and stopping necessary with hydraulic supplies may impose restrictions. For example, with some high-speed squirrel-cage motors starting duty has to be limited to about 12 starts/hour. In this case, control is by o.c.b's followed by air-break stator contactors. The o.c.b's give protection against overload, single-phasing, earth faults and short-circuits, while the stator contactors, which are provided with h.r.c. pack-up protection, are interlocked with the circuit-breakers. The author notes that no maintenance troubles have been experienced with these arrangements during several thousand operations.

Cranes

The economy of a.c. supplies for dockside cranes seems now well established. Supply is usually given from h.v. mains through ring-main units. It is considered desirable to duplicate cables feeding the watertight plug boxes which in turn supply the cranes through flexible trailing cables. Cables are in general p.i.l.c.s.w.a., led through ducts so far as old installations are concerned, although in new quay construction a chase covered with removable concrete slabs is preferred. Cranes require 415 V three-phase three-wire supplies, with 110 V supply for lighting and heating. Although strictly only three-phase supplies are required, the author prefers 3½ core cable for this part of the distribution system. The ½-core is used to ensure main earth continuity back to the substation independent of lead and armouring, and gives loop impedance between 0·006 and 0·26 ohm for little increase in cost. He warns that an earth circuit relying on contact between crane wheels and crane track is not acceptable.

From mechanical considerations, flexible cables are to be not less than 0·04 sq in., this size applying to three ton cranes.

If the advantages of a.c. are accepted, complication in crane control schemes are necessary, and the author analyses cost and characteristics of various schemes in some detail. An excerpt from this part of his paper is given in Table 1.

Looking to the future, the author considers the possibilities of using either an a.c. motor with voltage divider control supplied through a semi-conductor rectifier, or an a.c. slip-ring motor with speed control effected by two semi-conductor rectifiers, when the range has a control inverter feeding the slip energy back into the supply.

Maintenance

After dealing with the varied lighting requirements of docks, the author turns to discuss maintenance organisation. He suggests that when docks are grouped into large units, the maintenance staff should be just sufficient at each dock to carry out efficiently the day-to-day maintenance, emergency requirements and small new works installations. To deal with peak demand of heavy maintenance and new works, a mobile team centrally based and directed should be available, working to a programme for individual docks as required. A centrally controlled inspection team is desirable which can examine equipment annually. For a group of ports, a centrally sited winding repair and motor test centre can be justified.

DISCUSSION

Opening the discussion MR J. MONKTON (Mersey Docks and Harbour Board) remarked on the tremendous range and scope of electrical engineering in docks and how the design of any particular system of supply and utilisation was largely determined by local conditions and also the size of the ships handled by the dock. Regarding distribution, he disagreed with the use of overhead lines in dock areas because of the danger of contact with vehicles and mobile cranes. Nor was he in favour of air-insulated busbars in switchgear, his preference, based on experiences at Liverpool, being for the compound-filled type. He also quoted the practice in Liverpool of sheathing armoured cables with p.v.c. to prevent corrosion troubles, although this meant losing the earthing facility normally provided by the armouring. Referring to transformer overheating, he was surprised that the author had dismissed the use of Buchholtz protection, which he considered to be one of the best precautions against possible explosions. Turning to lighting, Mr. Monkton quoted the use of twin-tube fluorescent fittings for illuminating transit sheds at Liverpool docks.

MR G. A. WILSON (Port of London Authority) made a general comment as to the importance of the dock industry to the survival of the nation and how the use of electricity—though comparatively new in the dock industry, was rapidly outmoding steam and hydraulic power. He too, mentioned the wide range covered, including in recent years the application of electronic control and telecommunications. Regarding the quality of electrical equipment used under arduous dockside conditions, he considered that steelworks grade motors should be specified.

Details were given by MR A. J. PARSONS (Mawdsley's Ltd.) of the latest development in crane hoisting, using a modified Ward-Leonard system having a triple-field exciter, with the motor and generator fields automatically controlled according to the load on the hook. This method offered extremely rapid cargo handling. He endorsed the author's view regarding the high inertia of crane motors in common use, although he said the size of motor chosen was quite often governed by the performance required of it and not only because of temperature rise considerations. He suggested that a solution to the inertia problem was the use of so-called "rolling-pin" motors.

MR H. MOUNSTEN-HARRISON (POL), commenting on the second half of the paper, thought that the position of hydraulic pumps should be as near the c.g. of hydraulic load as possible. Putting forward the case for d.c.-motored cranes, he pointed out that these had been found to be very suitable for the wide variety of cargo handled by the POL. In this application he emphasised the importance of fast light-hook speeds in handling operations. For high-speed work effective braking was essential and should be good enough to give a dead stop in 3 ft with a fully loaded hook. Mr Mounsten-Harrison then went on to describe the type of crane plug-box installed by the POL, with particular reference to the methods employed to combat condensation. Turning to battery operated trucks, he said that the POL had found these to be far more economical than their diesel-driven counterparts.

The use of d.c.-powered cranes was also favoured by MR M. RUNDLE (POL), particularly in the case of high-speed quay cranes as used by the POL, of which as many as 100 were supplied from a single network. He did not think this would be very satisfactory using a.c. machines because of their voltage sensitive characteristics and the affect of intermittent loading on the power factor of the system.

Care in domestic wiring

POINTS FOR CONTRACTORS TO WATCH

by M. Neidle, Graduate I.E.E.

THE recent article in the ELECTRICAL TIMES* on the above topic recalls to mind the many difficulties which we have experienced in wiring occupied domestic premises. House wiring is all too often dismissed as beneath contempt by those engaged on larger sites. This is a mistake, for although this class of work may not bring great technical problems, if the completed installation is to reflect credit on the firm concerned, only the best craftsmen should be selected. Good character is also of great importance, since a good deal of the work is concealed and it is almost impossible to check every item of these hidden operations. Very skilled hands are essential for fixing fittings to newly decorated walls and ceilings, requiring care and thought in preparation. For delicate pastel shades, the fitting has to go on "first time" if redecoration caused by marked walls is to be avoided.

Insurance

Should unavoidable damage occur beyond the normal "give and take," insurance coverage becomes important. It is necessary to study policy terms carefully, especially since "third party" clause appears to vary with different companies. One might be forgiven for thinking that this form of insurance would cover, say, the cracking of a mirror (which contains an electric clock) inadvertently caused by a slip of the screwdriver when fixing. It is not possible to assume that the insurance company would automatically reimburse for the losses involved, simply because this was an accident caused to customer's property in the course of work. What might happen is that the assessors would class this as "incompetence" due to lack of skill. If however, the electrician's elbow had knocked down and shattered a valuable piece of cut-glass ornament whilst turning round to fix a switch, this would probably come under the terms of insurance for repayment. On the other hand, another company might take a different view. Sometimes the householder's own insurance contains accommodating clauses.

The contractor who does not employ a plumber for fitting immersion heaters must be especially careful. In one case after completion, the system was carefully gone over to see that there were no leaks or airlocks. However, it was not observed whether water was, in fact, circulating through the hot-water radiators. The result was that a burst boiler had to be offset against profits. The trouble was a jammed stopcock plunger, providing a hard lesson that checking cannot be too thorough.

Avoiding Trouble

Precaution is, of course, cheaper than cure. If, instead of genuine linoleum, floors are covered with the synthetic material known as "floor covering," it must be pointed out to the customer right from the start that with all the care in the world it is almost impossible to avoid tears in picking up this material if heavily tacked down. Even when lifting proper lino, in order to prevent damage it is usually worthwhile taking it up bodily in one piece, roll, tie with string and then stack in a corner. As an additional help for bedrooms with crowded furniture, valuable working space can be gained by taking the beds to pieces and placing these neatly in another room.

Where there are fitted edge-to-edge carpets, the services of the professional carpet-layer are normally required. This is particularly so where the room carpets are sewn to hall or landing sections. If only a small area has to be taken up, however, there is no reason why the electrical fitter, if he is careful, should not be able to perform this operation himself. On relaying, for perfect results the tacks should go back in their original holes.

Untold damage is caused by incorrect movement of step-ladders, through the knocking into paintwork, etc. This item of plant should be carried top foremost so that it is easy to keep an eye on the vulnerable part. To avoid marking walls through blind fixing of wall-lights, it is necessary to check keyholes and ensure really accurate centring of screws, with the correct distance projecting through the walls.

Damage caused by overall buttons can be avoided by wearing Service denims, where the buttons are of the "flush type." These, when they can be purchased from Government surplus stores, are even cheaper than the standard types. For jobbing work in our damp and muddy climate, a pair of goloshes is a useful asset; taking them off when entering proud Mrs Jones' residence forestalls complaints—and, incidentally, conserves shoe-leather.

Curly Charles' special brand of hair-grease can make for trouble when putting up chandeliers. The oil, if in contact with the ceiling, penetrates the paper and is practically impossible to eradicate.

Tools and Power Aids

To avoid damage through actual work, extreme care is necessary in the selection of tools. All cutting edges of saws, drills and chisels must be kept sharp in order to minimise hammering. Where possible, the use of power aids is a decided help in this. The electric drill need not be large, but requires more punch than the do-it-yourself variety. The wood-bit attachment rapidly bores smooth holes through joists. The small circular saw is ideal for cutting floorboards directly over joists prior to lifting, and is vastly superior to the padsaw method; it also comes in useful for cutting the tongues of T and G flooring. Long masonry bits, in all sizes, are now available for making holes through walls, reducing the jarring and damage which almost inevitably occurs when heavy blows are used for cutting away.

Contractors may also consider the purchase of the jig-saw adapter which can cut square holes in skirtings and elsewhere for BS 1363 13 A socket-outlet boxes, although bits are on the market with serrated sides which can be used for elongating holes.

* "Care When Contracting," by F. G. Stevens, ELECTRICAL TIMES, 5 January, 1961, p. 7.

It would be a great help if an enterprising firm of tool-makers could manufacture a wood-bit with a flexible drive, for use, say, in positions where trimmer joists are fitted tight against the wall. The need arises where p.v.c.-sheathed cables are required to pass from the floor-space to feed a socket-outlet. Even supplying a proper handle to the scotch-eye augur would be of assistance; at present improved wood handles have to be made by the operator on site. What is required is a solid metal cross-piece which can be passed through the eye and then locked in position by heavy nuts. It could be adjustable for one-hand operation in awkward positions.

Faulty Apparatus

An all-too-common source of irritation arises when, after carrying out what is believed to be an impeccable wiring job, one hits trouble with apparatus because of some oversight by the manufacturer. The installation engineer is struck by the many items of accessories and appliances which could do with improvement to make them more of a practical nature. These improved articles would not only save time, but also lessen the risk of damage through unnecessary difficulties.

As an example, consider the popular infra-red wall heaters. Conditions for fixing are often difficult enough, where, in a small bathroom, there is insufficient room to open the step-ladder fully and, therefore, the calf and bicep muscles are being strained during the whole of this fixing operation. In one model, loose connectors are supplied which require the use of both hands, while at the same time the heater has to be raised in order to take the weight off the loose connectors. In another type, the cables have to be entered into the terminals of a cord switch, the minute cable holes being buried deep in the fitting at an angle pointing upwards. Performing these trapeze acts can easily lead to accidental slips.

There are even hazards in what should be the simple matter of fitting the infra-red element. The saddle screws are far from being in the most accessible position and *both* of the screws each side have to be taken completely off. With cold hands, it is easy to drop and lose one of these irreplaceable items. If the makers supplied screws a fraction longer, only one would need to be undone and the saddle could then be swung to one side ready to accept the element. Longer screws with a tapered end, which could act as a lead, would be appreciated by the man on the job.

It is curious how some modern products perpetuate old out-of-date forms. A case in point is the simple bell. The modern underdome type is a great improvement in appearance but the grommet is for side-entry only, reminiscent of its old wooden brother. When will they produce them with back-entry for concealed wiring?

Light fittings are still sold in which it is impossible to use a screwdriver squarely for tightening the fixing screws. The only way an outside fitting of this type could be fixed in one case was by the use of spanner on coachbolts; it was fortunate on this occasion that it added to the "olde worlde" effect.

A good number of the contemporary light fittings as sold in the shops catch the eye, but should be roundly condemned from the electrical point of view. The householder proudly brings home "the latest" and the fitter is in the embarrassing position of salving his conscience by making the best job of fittings with "figure-8" plastics flex almost cut by unreamered tube ends, or pointing this out to the customer who too often says, "Well, if you won't fix it, I'll get Tom the window-cleaner." Many candle-lamp fittings still require to be constructed as a sound engineering job; the experience of the present writer is that it is impossible for the owner to re-lamp most of these chandeliers without an abnormal twisting of the flex.

The colouring of switch-wires in accordance with IEE Regulation 206 (A) should both be red. Sleeves of this colour are permitted, but a better installation would result if p.v.c.-sheathed cable with two red cores was more readily available.

One of the little-known advantages of p.v.c.-sheathed cable is the ability to mark the sheath with a ball-point pen to indicate circuits, etc. Cable lengths marked at yard intervals would be a time saver, and one sometimes wonders why some progressive cable-maker has not taken up the idea.

Offsetting the good points of polythene core insulation is its tendency to melt when subject to the direct heat of lamps in enclosed fittings. In this connection, the concealed metalwork white opal mushroom type is a particular offender. For safer installations, should not a spurt be made towards really advertising the advantages of the irradiated types—which have a much higher temperature rating—and thereby bringing down the costs?

P.V.C.-sheathed, polythene-insulated cables, where they enter the common batten holder, also suffer from this heating problem. Where appearance is not important, it is often worth while clearing the knockouts for ventilation to keep the cable ends cool. Again, one sees no insuperable difficulties or the need for increase in price for batten holders with perforated rims, which might even give that contemporary look.

Regulation 207G

Whilst ceiling pattresses appear to be the answer for compliance with Regulation 207G for enclosure of cables, there are snags even in the use of this simple fitment. Where three-plate wiring is used, such as for the carcase wiring of new homes, space in this pattress is strictly limited for the stowing of slack cable where three or four pairs meet at this point, with the additional possibility of earth wires. It is not surprising, therefore, that too often the whole purpose of the regulation is nullified through having the back of the pattress completely knocked out. The writer has seen this infringement on a number of housing estates. Thus, an alternative type of pattress with a bulge at the back to ease the crowding of cables would be a welcome innovation. One of the advantages of the old wood block was that it did allow a variety of fixing positions. If the pattress had four fixing holes, instead of two as at present, it would ease fixing problems. Screws through the ceiling rose and pattress also make for unnecessary difficulties; it would be easier if each item could be fixed separately.

Where it is not possible to fit a BS box flush into the ceiling, metal hook ceiling plates often present a contrast in colour to the white pattress which is not always to the customer's liking. Under these conditions, there appears to be no alternative but carefully to paint the rim of the pattress to match the metal finish.

Consumers Control Units

The increasing current rating of cookers are bringing additional problems, since it is too high for a 30 A way of a consumer's control unit. It therefore appears that we are being forced to take the retrograde step of requiring a separate switchfuse in addition to the control unit. However, now that area boards are, in suitable cases, uprating their 60 A service to take 80 A fuses, how soon are we going to see an EDA 80 A Consumer's Control Unit? In view of increasing loads, this would have obvious advantages.

FERRANTI LTD.

Progress in Manufacture—1960

IN another notable year of progress, Ferranti Ltd. have completed and dispatched large power transformers to customers, both at home and abroad, totalling over 3½ million kVA. Among these is one of the largest units ever to be delivered to the CEGB, a 225 MVA, 16/295 kV, three-phase transformer for Willingdon "B." The Board has also received a number of other large transformers up to 144 MVA rating, in addition to which there have been many deliveries of system transformers to the area electricity boards.

Overseas Deliveries

In the export market, deliveries have been well maintained. With several transformers commissioned, others in course of erection and the last in an advanced stage at the works, the Kariba contract nears its end. Other shipments to South Africa have included three 12·5 MVA and two 5 MVA, 132 kV units for the Electricity Corporation of Nigeria for their Western Region Scheme, and 10 MVA, 82 kV, 20 MVA and 35 MVA, 33 kV units for the Electricity Supply Commission of South Africa in Salisbury and Pretoria City, respectively. The Government of Qatar, in the Persian Gulf, has also taken delivery of two 10 MVA and two 5 MVA, 66 kV transformers.

In the USA, eight of the single-phase 154 kV transformers, up to 50 MVA rating, have been completed for the Tennessee Valley Authority, and a further nine of the 180 MVA three-phase transformers ordered by the Power Authority of the State of New York for the Niagara project, Lewiston plant, have been completed. This brings the total to date up to 13 and five of the last nine are already on site with erection coming along nicely.

Contracts Received

The most exciting order received during the year was for the 400 MVA, 380/275 kV three-phase auto-transformer for the Monk Fryston end of the 380 kV experimental line being erected by the CEGB. This is being built to gain operating experience at this voltage as a prelude to raising transmission line voltages in Britain in the not too distant future.

The home market has also produced orders for 275 kV transformers with ratings of 100 MVA, 120 MVA and 180 MVA, all for the supergrid and placed by the CEGB, as well as the related 144 MVA, 145 kV generator transformers and other units up to 60 MVA, 132 kV for grid and system reinforcement. The SSEB has also placed orders for 60 MVA, 132 kV transformers.

From abroad an order has been received from the Electricity Commission of New South Wales covering the supply of three 240 MVA, 16·5/348 kV generator transformers for Vales Point. An unusual feature of these units will be the aluminium tanks which have had to be used to meet transport limitations, since they are the largest transformers to be imported to Australia to date.

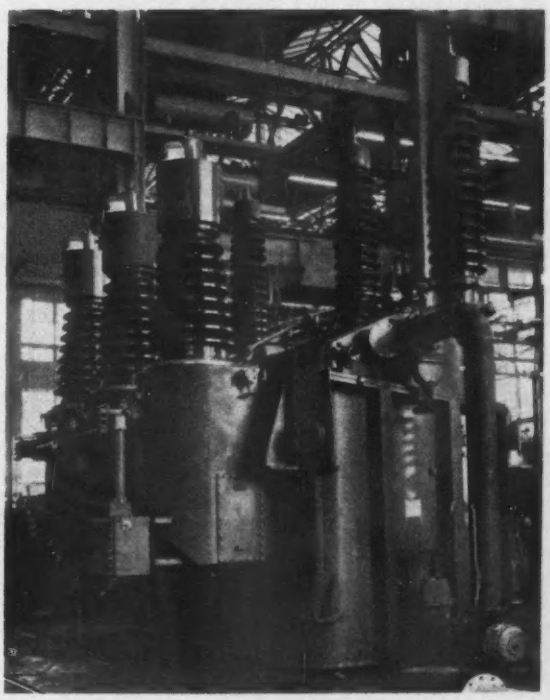
Ferranti on-load tap-changing gear is also in constant demand and has achieved an enviable reputation among users. A new development in this field is the 132 kV line-end tap-changer for the 135 MVA, 275/132 kV auto-transformers being supplied to South Africa. It will also be fitted to 180 MVA auto-transformers for the CEGB at Barking.

Testing Equipment

Apart from the usual range of orders for impulse, a.c. and d.c. laboratory and production testing equipments, two new contracts are worthy of note. One is from Finska Kabelfabriken, Helsinki—a 600 kVA, 4 MVA, a.c. testing equipment—and the other from Machinoimport, Moscow, the official importing agency for the USSR, for several a.c., d.c. and impulse testing equipments with ratings up to 1,500 kV, 2,000 kV and 3,600 kV, respectively. All of these equipments are complete with control, metering and ancillary gear.

Research and Development

Research, development and production facilities have been expanded during the year. A new core plate cutting machine which has been installed enables core plate laminations to be cut and pierced with an accuracy never achieved before and will deal with laminations two at a time up to 15 ft by 3 ft wide or, as a special facility, 3 ft 11 in wide.



The 135 MVA, 275/132 kV, 3-phase, 50 c/s transformer with line-end tap-changing equipment for the Electricity Supply Commission, S.A., undergoing test at Hollinwood

Personalities *in the industry*

Mr L. H. Welch

Mr J. P. Montague

Mr G. K. Robinson

Mr J. Corbishley

Mr. B. W. Ricks

Chief engineer of the London Electricity Board for the past seven years, **Mr L. H. Welch,** O.B.E., B.SC.(ENG.), M.I.E.E., is to retire in April next. He gained early experience with the BTH Co., serving as assistant construction engineer for London, Eastern Counties and Southern England. He joined the London Power Co. in 1927 as distributing stations engineer, and in 1936 was appointed to Central London Electricity Ltd. as distribution engineer. From 1944 to 1948 he was assistant chief engineer of the latter concern, and subsequently he became manager of the London Electricity Board's Northern sub-area.

Formerly a director of Nathan and Allen Ltd., **Mr J. P. Montague** has joined the staff of Small Electric Motors Ltd. as senior sales executive responsible to the board for all home and overseas sales activities of the company.

District commercial engineer at Altrincham to the North Western Electricity Board since April, 1957, **Mr D. G. Chalmers,** B.SC., A.M.I.E.E., is joining the Merseyside and North Wales Electricity Board next week as senior assistant commercial engineer (industrial development) at No. 1 sub-area headquarters (*ESH, page 157). Prior to going to Altrincham, Mr Chalmers held a similar post with the Board at Eccles.

Mr W. J. L. Millman, manager of the South Western Electricity Board's Holsworthy branch, has just retired at the age of 65 after over 40 years in the electricity supply industry. He commenced with the Okehampton Electric Light Co. in 1920 and later served in the Tavistock and Holsworthy areas, becoming manager at Holsworthy in 1934. He was active in the changeover of supplies from d.c. to a.c. in those areas. Mr Millman was the recipient of farewell gifts both from his staff at Holsworthy and from his colleagues at Okehampton, Bude and Bideford. His successor as manager at Holsworthy is **Mr J. W. Lyle,** who was until recently assistant district commercial engineer at Exeter.

Square D Ltd. announce the appointment of **Mr G. K. Robinson** as their Newcastle branch manager. Previously he was with the company's London field office as a field engineer.

At present principal secretarial assistant in the Croydon and West Kent sub-area of the South Eastern Electricity Board, **Mr F. J. Everitt,** A.I.M.T.A., A.C.I.S., is joining the London Electricity Board as district administrative officer, Borough district, as from 6 March (*ESH, page 81).

Mr Sam A. Gaskell, who has served Bruce Peebles and Co. Ltd. for some 32 years, having indicated his desire not to seek re-election at the next annual general meeting, has relinquished his position as chairman of the company, but will remain on the board. The new chairman is **Mr T. Coughtrie,** C.B.E., LL.D., who is also chairman of the Belmos Co. Ltd. which is involved in discussions on a possible merger with Bruce Peebles, as we earlier reported.

Captain I. R. Finlayson has been appointed superintendent in charge of the submarine branch of the Post Office engineering department, in succession to **Captain W. H. Leech,** who has retired. Captain Finlayson will be in charge of the Post Office's fleet of cable ships.

The council of the Institute of Metals anounces the award of the Institute's platinum medal for 1961 to **Major C. J. P. Ball,** chairman, Magnesium Elektron Ltd., in recognition of his "outstanding services to the non-ferrous metal industries and, in particular, to the magnesium industry."

Mr J. Corbishley, F.C.A., and **Mr S. A. Clodd,** M.I.PROD.E., have been appointed to the board of Ekco Electronics Ltd. Mr Corbishley is a director and financial controller of E. K. Cole Ltd., and Mr Clodd, who controls the Ekco factories, recently became a director of E. K. Cole Ltd.

For many years sales director of C. M. Churchouse Ltd., **Mr E. B. Cadman** is now managing director of a new lighting fittings firm, Candell Ltd. Manager of the latter concern is **Mr K. Dipple** (formerly of AEI Ltd.) and the principal designer is **Mr R. W. Whayling,** L.I.S.A., late of Atlas Lighting Ltd.

Mr B. W. Ricks, M.I.E.E., A.M.B.I.M., whose appointment as deputy chief engineer to the Eastern Electricity Board we briefly noted last week, is to succeed **Mr E. P. Burdett,** M.A., M.I.E.E., who is due to retire later this year. Mr Ricks, who is at present engineer of the Northmet sub-area, will also become the Board's operational research engineer (*ESH, pages 105, 110). Mr Ricks received his technical education at the Plymouth and Devonport Technical College and entered the supply industry in 1929 with the City of Plymouth electricity undertaking, serving in various capacities during his 20 years' service. He was concerned with the organisation and training of civil defence personnel and in the maintenance and restoration of electricity supplies during enemy air attacks on the city. In 1949 he became deputy engineer in the Torbay and West Devon sub-area of the South Western Electricity Board, moving to the Bristol and North Somerset sub-area 18 months later as planning and development engineer until 1955 when he was appointed an assistant chief engineer of the Board. He joined Eastern Electricity Board in 1957. Well known in EPEA circles for his service since he joined the

industry on both local and national committees, Mr Ricks is at present chairman of the Eastern Managerial Section.

Dr J. Reekie, general manager of Semiconductors Ltd., is being detached for special duties by the board of the parent company, Plessey Co. Ltd., and will shortly be visiting a number of overseas territories on behalf of Plessey. **Mr G. W. Pratt** has been seconded by the Philco Corporation, of America, to act as general manager of Semiconductors Ltd.

At present commercial engineer for the Merthyr and Aberdare district of the South Wales Electricity Board, **Mr W. H. Mills,** A.M.I.E.E., has been appointed manager of the Board's Rhondda district, in succession to **Mr E. Broughton,** A.M.I.E.E., whose appointment as manager of the Board's West Wales area we earlier reported (*ESH, page 132). Mr Mills, who takes up his new duties on 1 March, was educated at the Boys' County School, Aberdare, and the Treforest School of Mines, and commenced service in the industry as an electrical engineering apprentice with the former electricity undertaking of the Aberdare Urban District Council, and subsequently held various posts there. On 1 Oct., 1949, he was appointed commercial engineer for the Board's Merthyr district, and six years later, when a new district was created by the amalgamation of the operational and administrative units serving Merthyr and Aberdare, he became the commercial engineer for the new district.

Mr R. H. Boissier has been appointed London area manager for Aiton and Co. Ltd. in place of **Mr G. R. H. Trollope** who has resigned.

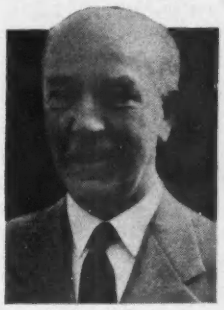
Mr D. Freeth, M.P. for Basingstoke, has been appointed Parliamentary Secretary to the Minister for Science—the first to hold that office.

Mr J. R. Rowlands, a director of Henry Simon (Holdings) and managing director of Simon Handling Engineers, has been appointed a director of Simon-Carves. **Mr G. P. Bridges** has retired from the board of Simon-Carves.

Mr R. De Beer, O.B.E., M.I.M.M., has retired from the Southern Rhodesia Electricity Supply Commission after ten years' service. His successor is **Mr E. H. Howman,** of Umtali.

Changes are announced in the team of senior sales executives in Hawker Siddeley Brush International Ltd., the company responsible for all overseas sales by the Hawker Siddeley Industries organisation. **Mr H. M. Loader,** D.F.H., M.I.E.E., has been appointed area director in Asia and the Far East, and **Mr G. R. P. Willan,** D.F.H., A.M.I.E.E., A.M.I.MECH.E., who has been the executive director based on Beirut, fills the position previously held by Mr Loader as area director for Africa and the Middle East. Both Mr Loader and Mr Willan are based in London.

Deputy chairman of the Electricity Council since its formation in Sept., 1957, **Sir Josiah Eccles,** C.B.E., M.M., D.SC., M.I.C.E., M.I.E.E., M.I.MECH.E., is to retire from that position on 31 July next in order "to make way for younger men." (*ESH, page 45.) From 1953 to 1957 Sir Josiah was deputy chairman of the Central Electricity Authority, and for the previous five years was chairman of the Merseyside and North Wales Electricity Board. He also served as a part-time member of the BEA during its first years, having previously been a member of the Organising Committee which planned the changeover to nationalisation of the Electricity Supply Industry. Sir Josiah will have completed an outstanding career of 33 years in the industry, for he was with the Edinburgh Corporation undertaking from 1928 to 1943 (latterly as engineer and manager), then city electrical engineer at Liverpool from 1943 to 1948. He was the last president of the IMEA, chairman of EDA Council in 1948-49, president of the BEPC in 1957, and has also served on numerous other committees concerned with the industry.



Sir Josiah Eccles

Councillor Mrs D. Neate, J.P., who has been chosen as mayor-elect for Winchester for the coming municipal year, has been a director of Riley and Neate Ltd. since it became a limited company in 1939 and took an active part in the establishment of the original partnership. Mrs Neate, who is also a director of Preformed Line Products (Gt. Britain) Ltd., has been a member of Winchester City Council for many years and has served on almost every committee.

Mr R. G. Terry, export manager of South Wales Switchgear Ltd., left London on Monday on a three-week business trip to South America and the West Indies, including visits to Argentina, Brazil and the Caribbean islands. He expects to return in the second week of March.

General manager of the New Brunswick Power Co., **Mr R. E. Tweeddale** was recently presented with the "Electrical Man of the Year" award for the whole of Canada in recognition of his work in establishing the Nova Scotia to New Brunswick grid link.

Mr K. C. Acutt, deputy chairman of the Anglo American Corporation, has retired from the Federal Power Board of Rhodesia and Nyasaland. He has served as a member of the Board since its formation in 1956 and, now that the Kariba project is in full operation, he feels that the purpose of his appointment has been fully served.

Spearheading an export drive beginning in Australia, two executives of AEI-Gala Ltd., the associate company of AEI-Hotpoint, **Mr J. Donald** and **Mr B. Healey,** left London last week and met their managing director, **Mr D. T. L. Rettie,** at Beirut. They arrived in Sydney on Tuesday and move on to Melbourne next week-end.

The Council of the recently formed Drop Forging Research Association has appointed **Mr P. H. R. Lane,** B.SC.(ENG.), A.I.M., A.M.INST.W., to be its first director of research. Mr Lane takes up his appointment in Sheffield on 1 March. For the past 12 years he has been with the British Welding Research Association where he was head of the Members' Service Department. The latter post is being taken over by **Mr R. P. Newman,** A.M.I.MECH.E., formerly in charge of fatigue researches at the B.W.R.A., and **Mr T. R. Gurney,** M.A., A.M.I.C.E., succeeds Mr Newman.

After 30 years' service with the Electrical Insulation Department of Turners Asbestos Cement Co. Ltd., **Mr F. C. Banton** has retired from his position as Birmingham branch manager. He has been succeeded by **Mr D. Lewis,** who has already served four years with the company in the Midlands area and who was previously with Crompton Parkinson Ltd. and the English Electric Co.

OBITUARY

Mr N. Axford, B.SC., M.I.E.E., who retired in 1958 as district manager at Plymouth to the South Western Electricity Board, has died, aged 63. He was district manager at Plymouth from Jan., 1950, earlier holding a similar position with the Eastern Electricity Board, and the Northmet Power Co. for about 12 years. He joined the latter company in 1923 after early training with the BTH Co., and he was resident engineer at Wood Green for 14 years before going to Harrow. Mr Axford was a vice-president of the Association of Public Lighting Engineers, and a past-chairman of the Plymouth Electric Club.

Mr S. T. Coulson, a former chairman of Richardson Westgarth and Co., has died, aged 94.

* *Denotes revision to the "Electricity Supply Handbook, 1960."*

Mr J. M. Murray, manager of the Cirencester office of the Southern Electricity Board for the past six years, died last week, aged 64.

Mr R. Y. Sanders, F.S.S., F.R.ECON.S., F.R.MET.SOC., formerly deputy commercial and development adviser to the Electricity Council, died on 3 Feb. Since retiring from that post in September, 1959, he had continued to serve the Council in a consultative capacity. Mr Sanders was one of the first officers appointed to the headquarters staff of the Central Electricity Board on its establishment in 1927, serving successively as statistical officer, development officer and, from 1943, as head of the Development and Economic Section. He was also secretary of the Board's National Consultative Committee from 1944 to 1948. In 1948 he became deputy commercial manager to the BEA and later became deputy chief commercial officer. Mr Sanders has held many important positions in the supply industry. He was chairman of the Utilisation Research Committee of the Central Authority and the area boards from its inception and was chairman of the three Utilisation Research Panels of the Electricity Council which replaced that committee. He was a member of the Electricity Supply Research Council and of the Council of the Electrical Research Association. For many years he served on committees of the UN Economic Commission for Europe and the OEEC and on both the Directing Committee and some of the Study Committees of UNIPEDE. He was a member of the delegation from the supply industry which visited Russia in 1956.

Dr C. V. Drysdale, C.B., O.B.E., D.SC., M.I.E.E., F.INST.P., F.C.G.I., F.R.S.E., M.R.I., inventor of many electrical and optical instruments, died on 7 Feb., aged 86. He was assistant head of the Department of Electrical Engineering and Applied Physics at Northampton Institute from 1916 to 1919, being also a partner in H. Tinsley and Co. Dr Drysdale then joined the Admiralty Experimental Station, being director of research to the Admiralty from 1929 to 1934. He was also editor of the *Journal of Scientific Instruments* in 1927-28 and was author of textbooks on a.c. theory and electrical measuring instruments.

Mr J. H. Aston, managing director of Tube Investments Ltd. from its incorporation in 1919 until 1941, and then chairman till 1944, died on 12 Feb., aged 90.

Mr T. Woods, associated with Downes and Davies Ltd. for over 50 years, first as a partner and latterly as joint managing director, has died. He was president of the EWF in 1940.

Mr L. S. Wright, for many years London manager of Geo. Bray and Co. Ltd., died recently, aged 48.

Mr J. M. Barker, formerly district commercial engineer at Morpeth, to the North Eastern Electricity Board, has died. He retired some 18 months ago.

Mr Frank Mitton, founder of the Northampton electrical contracting concern of that name, has died aged 77. He founded the business in 1927.

Materials for Electrical Design

ALL-GLASS PAPER

APPLICATIONS for Tissuglass, a sheet of matted sub-micron glass fibres made on a specially adapted paper-making machine, are extending well into the electrical field, according to reports from the USA. A recent development is use of the material as a base for electro-luminescent lamps which may involve production of flexible panels as thin as $\frac{1}{16}$ in. Another application is in resistance strain gauges. Tissuglass is produced in widths of up to 38 in. and in continuous rolls. *Marketed in UK by AMF Ltd., 4 Savile Row, W.1.*

Properties of Tissuglass

Melting temperature ...	About 1,200°F
Thickness	0·0006 in. to 0·012 in.
Pore sizes	8 to 90 micron
Voltage strengths ...	370 to 2,370 V

NYLON BEARINGS

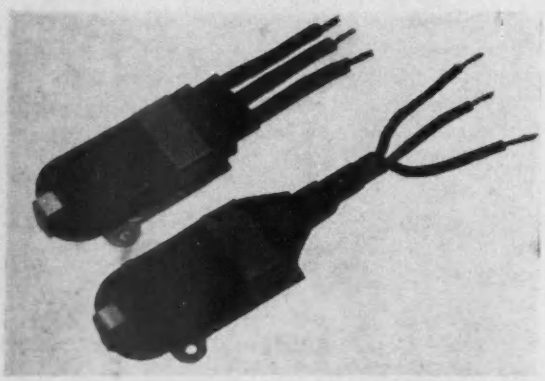
NYLON tubes are available in 116 standard sizes for use as bearings in a range offered by Polypenco. Full size range is from 2 in. o.d. by 1 in. i.d., to 15 in. o.d. by 14¼ in. i.d. The nylon used is the company's special formulation produced particularly for bearings and wear-part applications. It offers the advantage of ready machinability, with the possibility of weights as low as one-seventh of those of equivalent size bronze bearings. Nylon bearings, of course, operate with little or no lubrication. *Polypenco Ltd., 68-70 Tewin Rd, Welwyn Garden City, Herts.*

RIGID EXTRUDED SHEET

THERMOPLASTIC sheet suitable for exterior application is Sarrac, a polystyrene based material offering good thermal, abrasion-resistance and impact properties. It is available in sizes up to 100 in. by 48 in. and in thicknesses from 0·020 in. to 0·180 in. Manufacturers claim that its high elongation and marked absence from cracking permit it to be thermoformed, sawn, sheared and otherwise worked with less difficulty than with most plastics. The material has good resistance to aqueous acids, alkalis and salts. *Saro Products Ltd., Folly Wks, Whippingham, East Cowes, Isle of Wight.*

Physical Properties of Sarrac

Tensile strength 60°C 22°C	3,100 lb/sq in. 5,000 lb/sq in.
Thermal co-efficient of expansion	10^{-5} in./in./°C
Falling weight impact strength (BS 2782) ...	10·75 ft/lb for 0·060 in. sheet
Heat distortion point (ASTM 264)	85°C



Neoprene synthetic rubber is used to provide a complete enclosure for these French-designed industrial circuit-breakers, called "Minirupteur". The system of make-and-break in these units is based on a thin S-shaped metal plate. The neoprene gives protection from dust-laden atmospheres, water and chemicals

PRICE REDUCTION

LOWER prices are applying to Du Pont "Delrin" acetal resin, which is now to sell at 65 US cents/lb delivered to main European ports. Delrin is described as a tough, rigid engineering thermoplastic designed primarily for use in fields now dominated by die-cast metals. Although heavier than many plastics, it is 80% lighter than zinc, 45% lighter than aluminium and over 20% lighter than magnesium. A highly crystalline high-melting-point polymer, it is claimed to be extremely rigid without being brittle. It has a low coefficient of friction and high dimensional stability. One of the applications so far developed is instrument cluster housings in cars and the like. *Marketed by Du Pont de Nemours International SA.*

Electrical demands in sugar refining

POWER AND PROCESS STEAM UTILISATION AT PYRMONT

by E. G. Williams, M.E., A.M.I.E.Aust., A.M.I.E.E.

IN the first section* the layout of the steam and electrical generation plant of the Colonial Sugar Refining Co.'s group of factories at Pyrmont, Australia, was described. We shall now consider the application of the two products, process steam and electricity, to the most important of the factories, the sugar refinery. Although this unit presents the greatest variety of utilisation it is not the largest electrical consumer. The maximum demand, of the order of 2,700 kVA with a weekly consumption of around 157,000 kWh, compares with 3,100 kVA and 237.000 kWh of the building materials factory. From the point of view of technical interest, however, the refinery is by far the most important.

Bulk Raw Sugar Handling

All raw sugar received at Pyrmont arrives by sea, the specially designed bulk-sugar ship, the m.v. *Meringa*, docking every ten days. The ship berths under the two 270-ton transporter cranes on the company's wharf, each of which can "grab" four tons of sugar at a time. The control cabins and hoist motors travel and rotate on the luffing booms so that the driver is always immediately over his load. The grab discharges its load into a hopper in the crane structure from which a belt conveyor transfers it to other conveyors that transport the sugar to the weigh station on the wharf. Here the sugar is weighed out, 24 tons at a time, and transferred to the bulk storage sheds by a further system of conveyors and movable ploughs where it is deposited in mounds on the shed floors. Over 50,000 tons of raw sugar can be stored here and resembles small white mountains until it is removed by an electrically driven excavator at a rate of about 100 tons/hr. The sugar is weighed into trucks which deliver it to elevators for transport to the top of the melt house. At this point the refining process starts.

* ELECTRICAL TIMES, 19 Jan., page 99.

Sugar Refining

The object of sugar refining is to eliminate impurities and bacteria from the raw sugar so that the resultant product is a pure food, attractive in appearance with good keeping and handling properties. The refining process is a series of physical treatments. Although some chemical reactions are involved, these occur mainly in materials used for filtering and decolourising the sugar itself. In fact, great care is taken in process control to prevent chemical change in the sugar since this would represent a loss in pure sucrose.

The basic process is shown schematically in Fig. 2. Since most of the impurities are contained in the outer surface of the raw sugar crystal, the first treatment, "affination," is to dissolve away the outer surface leaving the inner crystal intact. Raw sugar is mixed with a saturated syrup in which the outer surface dissolves, after which crystals and syrup are separated by spinning the mix in centrifugal separators.

At Pyrmont, the separators are hydraulically operated, the 150 lb/sq in. water supply being derived from three electrically driven pumps. The motors driving the pumps are a major load on the electrical system and it is proposed to reduce the electrical demand at this stage by installing electrically driven separators in the near future.

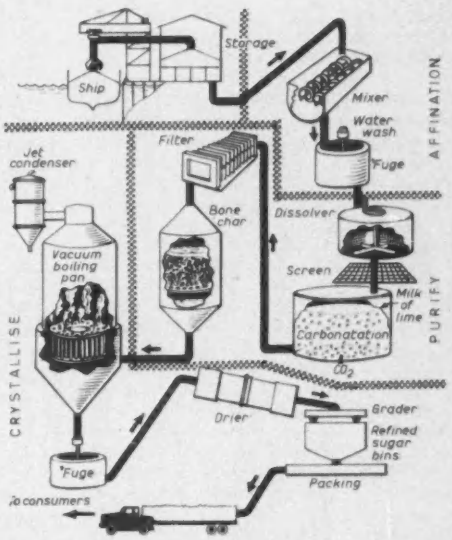


Fig. 2. Schematic diagram of the sugar refining process

Purification

Crystals left in the basket after centrifuging are ploughed into a screw conveyor which takes the sugar to the melters. Here the crystals are dissolved to a syrup of definite density. A notable feature of the refinery is the tall multi-storey buildings. The plant design is such that sugar in the solid or semi-solid state will move from stage to stage under gravity. When it has to be raised to the top of the next building it is convenient to have it in solution so that it can be pumped. Electrically driven pumps and conveyors are used extensively, the latter taking many forms; scraper, shaker, band, bucket elevator, etc.

Carbonation

Syrup formed by melting the washed sugar is run into 15,000 gallon tanks where it is mixed with a lime solution. Flue gas from the boiler station stacks, containing 10% carbon dioxide, is pumped through the tanks forming a fine precipitate of calcium carbonate which acts as a filter in the next process. Here, the syrup, with the precipitate in suspension, is pumped through large plate-type filter presses which remove the undissolved impurities.

The filtered liquor is now quite pure but still has a brownish colour which

Fig. 1. 50,000 tons of raw sugar is represented by these mounds on the floor of the storage shed

would impair the final appearance of the product. To remove the colour the syrup is run through large containers packed with bone charcoal ("char") which is a porous framework of calcium phosphate containing about 10% activated carbon. The carbon has a strong bleaching action, absorbing colouring matter and metallic salts.

Char Treatment

Although the filtration and treatment in the char requires little electrical power or equipment, the revivification of the bone charcoal represents one of the larger demands on the system. The exhausted char has to be conveyed, passed under magnetic separators and transferred to an automatic kiln where it is revived, graded and transferred pneumatically back to the char cisterns for re-use. Fig. 3 shows the general construction of a char-reviving kiln. The char passes over the hearths in alternating directions while hot gases from the down-draught burner adjacent to the kiln are passed upwards through the char carbonising all the impurities and organic matter under carefully controlled conditions, so reviving the material which is too expensive to employ only once. The treatment, which takes place at a temperature of approximately 1,000°F, must be carried out in the absence of oxygen or air to prevent oxidation of the active carbon. Control functions, from relays and instruments housed in a pressurised control room, include level control in the coolers (by photo-electric means), oil supply shut-down in the event of flame extinction, temperature control of the burner and programmed starting and stopping sequences. The revivification process takes up some 10% of factory space and requires a complex control system.

Crystallisation

After the char treatment the sugar liquor, now clear and colourless, is passed to the vacuum boiling pans. By carefully controlled boiling at approximately 140°F a supersaturated liquor is made. At a critical moment the liquor is "seeded" with a cupful of small sugar crystals. These trigger off the natural formation of crystals in the liquor and, by careful control of the boiling and the rate of entry of fresh liquor into the vacuum pan, the small crystals grow to a commercial size.

Modern vacuum pans are large. The "O" pan at Pyrmont holds 13,000 gallons (75 tons) of crystals and syrup at the end of a pan cycle. The steam demand is some 50,000 lb/hr at 15 lb/sq in., which is equivalent to 17,500 kW if electricity were to be used for evaporating. Vacuum maintenance is by electro-mechanical controllers regulating the flow of salt water to the jet condensers at the top vapour outlet of each pan. On the large pans the steam valves are also electrically operated. A conductivity meter and a viewing microscope assist the operative in charge of sugar boiling to control the rate of crystal growth. The mixture of crystals and syrup is next dropped through a slide valve in the bottom of the vacuum pan into cooling troughs. The "massecuite," as the mixture is called, flows through individual gates to the separators and, once again, centrifugal force is used to remove the syrup, leaving a 6 in. wall of slightly damp, refined sugar crystals around the basket. These are ploughed off and fall down through a large valve in the bottom of the basket.

Fig. 4 shows one of these electrically driven centrifuges. The two-speed 60 h.p. driving motor is mounted above the machine while, at the right of the picture, the control and indicator panels can be seen. Electrical and electro-hydraulic controls enable the operator to select any one of the following operations:

1. Charging or filling the basket with massecuite.

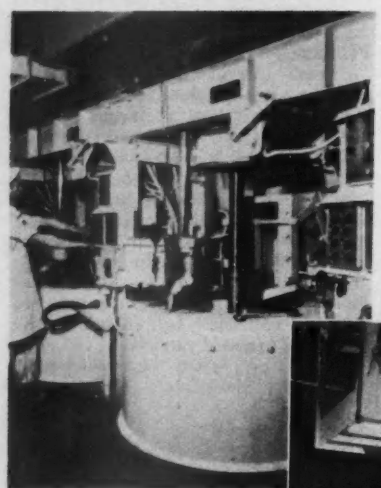


Fig. 4. A two-speed electrically driven centrifuge for removing syrup from the massecuite

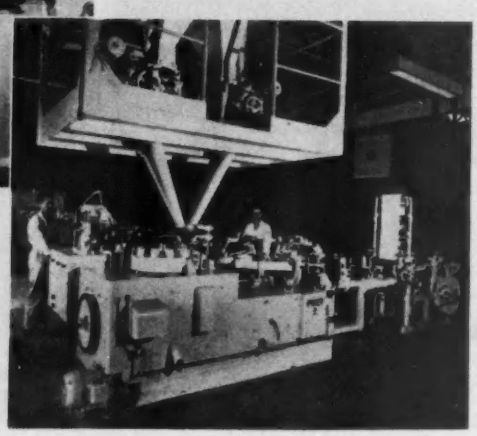


Fig. 5. This automatic packaging machine prints and folds 2 lb bags, fills them, seals and delivers at the rate of one per second

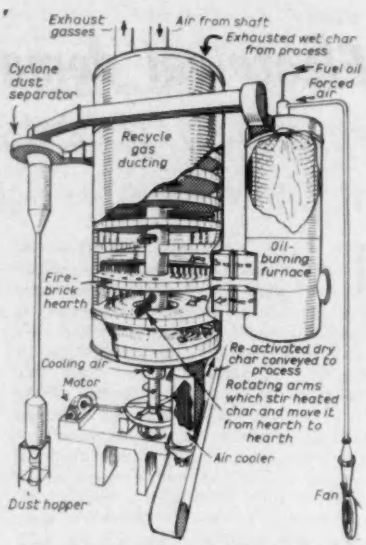


Fig. 3. Schematic diagram of a char-reviving kiln

2. Low-speed centrifuging—480 r.p.m.
3. High-speed centrifuging—960 r.p.m.
4. Water wash.
5. Regenerative braking to 480 r.p.m.
6. Mechanical braking.
7. Ploughing.

Normally, the operator only charges the centrifuge basket, leaving a programme controller to carry out a predetermined cycle of operations. The programme controller and the associated control panel are not shown, but they constitute an intricate and interesting electrical system. Interlocks ensure that safety requirements, such as correct parking of the plough blade, are met while governor switches check the controller to ensure each operation will be carried out at the correct speed. The ploughing speed of 55 r.p.m. is obtained by connecting the low speed winding to a special 5·5 c/s frequency-changer which supplies the six machines.

The a.c. pole-changing induction motors on the machines are of robust construction, but their electrical demand on the supply system is severe and maintenance of the control gear is sometimes a problem. Peak accelerating powers of approximately 150 h.p. are required and 300% f.l. current peaks occur at regular intervals. The cycle time of each centrifuging process is approximately three minutes. Diversity between the centrifuges and regenerated power helps to reduce the effect on the system.

The refined sugar crystals from the separators are conveyed to rotating inclined drum driers. After drying from 2% to less than 0·1% moisture the sugar is graded into three classifications. These are:

LXD—coarse for jam making, etc.

1A—normal granulated for general consumption.

Caster—fine grain used for special preparations, such as the manufacture of cake mix.

The driers, conveyors and graders are all electrically driven. One of the main operating problems is to provide over-

load protection which will prevent damage to electrical and mechanical plant if a blockage occurs, yet will not interrupt production unnecessarily should operators cause momentary overloading.

Packing and Packaging

After passing over magnetic separators the graded, refined sugar is conveyed to one of the following stations:

(a) 70 lb bag filling.
(b) Bulk granulated delivery.
(c) Retail packaging.

All sugar sent out from the refinery, except for liquid sugar, passes through one of these stations. Liquid sugar is taken from the process flow either before vacuum pan boiling or as syrup from the refined sugar centrifuges. Tankers are used to deliver it.

One of the electrical problems in this area is to light the storage bins, which contain a dust that can be explosive, with dust-tight unbreakable fittings. Broken glass must be avoided at all costs. Moulded "Perspex" diffusers are invariably used.

The 70 lb weighing machines fill hessian sacks which are vibrated on rocking "chairs." The sacks then descend via chutes and slat conveyors to the delivery docks. Bulk granulated sugar is weighed into a ten-ton bin from which it is transferred to a special tanker. This tanker has an a.c. motor-driven screw conveyor for discharging at the delivery point.

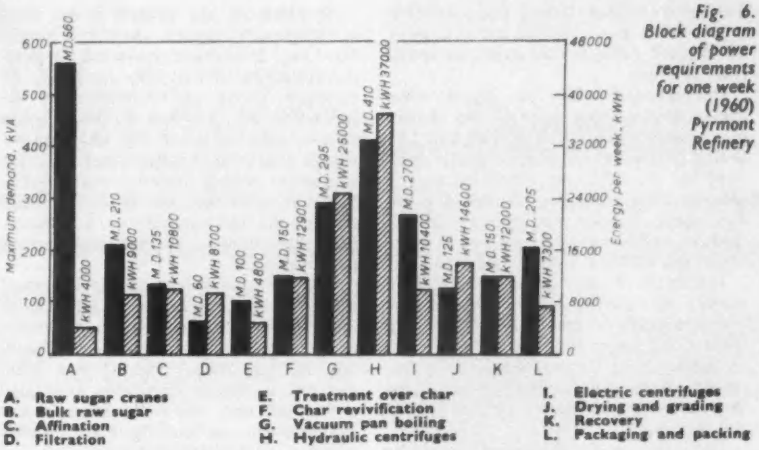
Retail Packing

Retail packaging is a fairly recent addition to the factory. The automatic packaging machine, which is shown in Fig. 5, fills and delivers 2 lb packets at the rate of 60/min. It also prints the paper and folds the packet. Electric interlocks are many and varied. Some check for paper breakage, packet misalignment, etc., whilst others control the discharge of the weighing machines mounted above the packaging machine. A continuously operating automatic unit such as this packaging machine introduces problems of sugar supply and package delivery. Variable speed conveyors and diaphragm level controls are incorporated in the supply lines.

The filled and sealed packages travel along small conveyors to a parcelling machine which parcels 16 2 lb packages in a matter of seconds. This also has a fairly complex electrical control system. Parcels are then conveyed to the warehouse by belt conveyors.

Centralised Control

The whole system from the time the bulk sugar passes over the magnetic separator on its way to the retail packaging station until the parcels arrive at the warehouse can be regulated from a central control point. By using miniature type control gear it was found possible to install all control equipment in a sheet-metal housing 7 ft high by 10 ft long by 4 ft wide. The front of the housing is used as an indicating and control panel and controls are laid out on a flow diagram. An interesting feature of this flow diagram is the use of work



A. Raw sugar cranes
B. Bulk raw sugar
C. Affination
D. Filtration
E. Treatment over char
F. Char revivification
G. Vacuum pan boiling
H. Hydraulic centrifuges
I. Electric centrifuges
J. Drying and grading
K. Recovery
L. Packaging and packing

Fig. 6. Block diagram of power requirements for one week (1960) Pyrmont Refinery

study symbols — operation, storage, transport, etc.—engraved in translucent plastics material.

The retail packaging plant was also the first installation in the factory to use a motorised pulley for a conveyor drive. The stator and terminal box are stationary, whilst the rotor drives the outside drum through a simple epicyclic gear train. The motor windings are insulated with an epoxy resin and run in oil which acts both as lubrication and as a coolant. The main cooling of the unit is by conduction into the conveyor belt.

Geared motors are also used extensively. An endeavour has been made to standardise the range of motorised pulleys and geared motors to simplify the spares problem.

Electrical Maintenance and Housekeeping

The importance of good quality electrical maintenance has increased with the growth in magnitude and complexity of industrial electrification. To achieve reliable plant operation and low maintenance costs, the electrical maintenance team must be carefully selected and trained. In a large establishment, such as at Pyrmont, this is a major problem involving professional engineers, technicians, supervisors, shift electricians, turbine drivers and tradesmen. This team is responsible for the electrical maintenance of a power station, two factories and the efficient operation of the generating plant.

Training is by suitable rostering of key men on shift and testing work and by illustrated lectures. These lectures, which are given by the engineer, describe the principles of operation of the various sections of the plant and also deal with technical details and routines affecting safety, accident prevention, fire fighting and artificial resuscitation.

Financial Control

Financial and technical controls of maintenance are thorough and workable. The electrical engineer attends a managerial maintenance budget conference each week. The budget policy is passed on at a monthly conference with the electrical department supervisors. Major maintenance work is planned and included in the budget for the next half-year.

Technical Control

Technical control is aimed mainly at preventive measures. The basic components are master plant record cards, record slips that file with the master card and instruction and reporting cards for use by tradesmen on the job. A technician is in charge of this system. The testing section does all high voltage insulation testing, overload testing and performance tests called for by the system. Care has been taken to ensure that periods between preventive maintenance are reasonably long so that programmed work will not fall behind schedule. The system tries to avoid unnecessary overhauls at specified periods by the use of non-destructive tests and systematic preventive maintenance. Quarterly, half-yearly and annual instructions are given a suitable prefix, Q1, H1, A1, etc.

It has been found that maker's circuit diagrams used for the installation of complex plant are often unsuitable for maintenance purposes. Non-standard symbols are frequently used and a clear schematic diagram is rarely included. A small electrical drawing office staff draws up-to-date, clear schematics with the emphasis on ease of trouble-solving and with symbols conforming to BS 108: 1951—"Graphical Symbols for General Electrical Purposes."

The adoption of only first-class electrical equipment at Pyrmont during the last ten years is now paying dividends in reduced maintenance costs. The 6,600 V alternators are in good condition as is also the 6,600 V switchgear. The protective relays are overhauled bi-annually by Sydney County Council engineers. The 440 V switchgear operates at full rating and some trouble has been experienced with excessive sludge formation and temperature rise in the o.c.b. tanks. It is being overcome by increased finger pressure on the main contacts and the use of a passivated oil.

The 1,000 kVA and 500 kVA transformers are not fitted with conservators. Silica gel breather replacement is frequent and some corrosion under the lids has been experienced. A rise in oil acidity above 0·5 mgm KOH/gm usually means

that corrosion has started. The corrective action taken is to replace the oil, clean off affected surfaces and apply an epoxy resin coating.

Underground cables are tested when the switchgear and busbars are undergoing six-monthly overhaul and test. The testing technician does this work using a 10 kV d.c. test unit. Fault location is also carried out using a Murray loop set. For check location and proving of the fault he calls on the services of engineers from the Sydney County Council.

Induction motor repair is confined mainly to bearing failures except for recent winding failures in two fairly large units. The latter failures are attributed to vibration of the end turns under frequent direct-on-line starting conditions. A.C. commutator motors require regular maintenance.

Industrial control gear operating under severe conditions, such as on the cranes or centrifuges, requires careful attention. The advent of BS 775:1959—"Contactors" was welcome since it provided a sound basis correlating contactor rating with the required duty. Automatic control systems necessitate a high standard of staff training to achieve rapid trouble-shooting and worth-while preventive maintenance.

At Pyrmont, key control items, such as programme timers, electronic amplifiers, etc., have been converted to plug-in connection so that they can easily be removed, tested and calibrated in the test laboratory. The test section also has plug-in monitor panels for checking involved operating sequences such as crane equipment during lowering and hoisting. Speed switches are checked on a special unit in the test laboratory. A cathode-ray oscilloscope in the laboratory often proves useful.

The managerial demands for improved housekeeping and safety in the factory areas are in accord with the requirements of good electrical maintenance. Tracking of insulation, one of the main hazards, is almost invariably associated with dust and moisture. Some recent developments at the Pyrmont refinery which assist housekeeping are:

(a) Centralised control of related motors and equipment. This enables one dust-proof cabinet to be used, often large enough for walk-in access for maintenance personnel. Good interior lighting permits ready inspection of the control gear.

(b) The use of miniature control gear with satisfactory rating and integral overload devices. These units permit the use of smaller control cabinets or, conversely, all the control gear for a given process to be accommodated in a compact arrangement in one large cabinet.

(c) The use of multi-core plastics insulated and sheathed cables for motors rating up to 20 h.p. and for control wiring. The sheath of this cable is orange-coloured to ensure correct colour identification.

(d) The introduction of geared motor and motorised pulley drives.

(e) Emphasis on good housekeeping in test and maintenance instructions.

(f) Increased attention to painting and labelling, especially on new construction work. A standard colour scheme is adopted.

The response by the staff to this programme has been excellent. Supervisors and men take a pride in maintaining the standard. The accident frequency rate in lost-time accidents/million man hours for the department (40 men without counting turbine drivers) has fallen steadily as these figures show:

Year	1957	1958	1959	1960
Accident Frequency Rate	34	34	11	Nil

Fighting Electrical Fires

THE presence of electrical equipment in or near the seat of a factory fire may or may not be a sound reason for attributing the cause to electricity, but it certainly is a factor which has to be taken into consideration when dealing with the outbreak. Prompt use of fire-fighting equipment in the correct manner will, in the majority of cases, limit the extent of damage and prevent a major conflagration with attendant risk to life and property, but the significant factor is invariably the extent to which the term "in the correct manner" is understood by those in the vicinity.

The first step, naturally, is to see that all electrical services in the affected area are isolated from the supply, not only because fire-damaged insulation can lead to arcing, but also to remove the risk of fire-fighters getting a shock either by direct contact with live equipment or through the extinguishing liquids. This can be carried out by one person while others are already attacking the blaze with existing first-aid fire-fighting appliances and the general alarm is being raised.

There are several types of first-aid equipment which may be used and, of those which may be available close to the fire, the selection will largely depend upon the inflammable material which is contributing to the blaze or might be involved.

Types of Extinguisher

All factory personnel should be familiar with the different types of extinguisher, their correct manner of use and the circumstances in which they should be used. A booklet which has just been published for the Ministry of Labour* details this information with admirable clarity.

Broadly speaking, extinguishers fall into three groups: powder, gaseous and liquid. Powder extinguishers serve either as a blanketing device (dry sand, etc.) or as a generator of CO_2 through decomposition. The latter usually are based on compounds of carbonates and bicarbonates, apart from special powders developed for metal fires. The powders can be applied either direct from a canister or as a cloud from a jet on an inert gas such as nitrogen or CO_2.

Gaseous extinguishers range from the CO_2 fixed installations to the generators of the acid-soda type. The latter also include a proportion of water expelled at the same time.

Liquid extinguishers range from the plain coolant type, such as water or water spray, to the chemical types which decompose to form heavy extinguishing gases. Many of these are toxic and should not be used in confined quarters.

Finally, there are the foam extinguishers which blanket the area with a porous mass of gas-containing foam and are particularly effective in extinguishing heavy oil fires.

Electrical Fires

Fires involving electrical equipment which cannot be made dead, or are the result of electrical faults still in being, should not be attacked by water jet since the risk of shock to the fire-fighter is high. Water spray is just as effective and involves no risk at normal voltages though, if burning oil is escaping from the apparatus, foam is the best attack, particularly if the oil is escaping at a rate resulting in a running fire. Dry extinguishers can be used to dam the flow and localise the flaming area. Water in jet is completely unsuitable since it will tend to disperse the flaming liquid over a larger area. Vapourising liquids can be used on electrical fires without shock risk and providing that they are not in confined areas.

Sometimes fire in electrical plant may be accompanied by explosions which will assume such proportions as to be beyond first-aid extinguishing efforts. Where such a risk is evident, the surrounding structure should be so designed as to localise the fire, and manual or automatic controlled static CO_2 systems should be installed. In power stations with hydrogen-cooled alternators, means should be provided to cut off the supply of hyrdogen and to purge the system with an inert gas such as nitrogen.

Generally speaking, while the ordinary standards of provision of fire-fighting equipment will suffice for an individual electric appliance and its control gear, increased provision should be made where there are concentrations of electrical equipment or where the equipment includes oil-filled apparatus or large quantities of lubricating oils. Suggested standards are given in the booklet referred to above.

* "Fire Fighting in Factories," No. 10 in the series "Safety, Health and Welfare," HMSO, price 2s.

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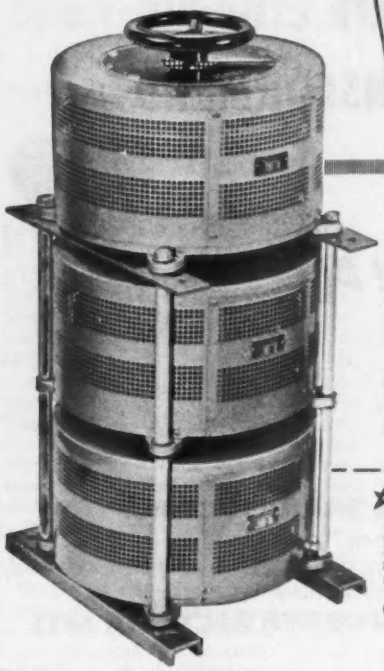

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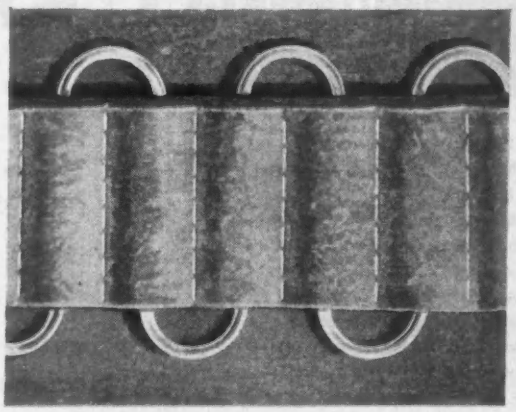

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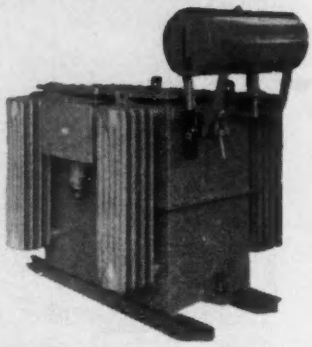

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Open-circuits in three-phase motors

SINGLE-PHASING AND OTHER FAULTS IN COMMON EXPERIENCE

by J. L. Watts, A.M.I.E.E.

IN order that an induction motor shall be self-starting when switched on it is necessary that a revolving magnetic field be created by the stator currents. This is normally produced by the combined effect of alternating fluxes in different parts of the stator, the peak values of which occur at different instants. The space displacement of the fluxes is, of course, obtained by suitable distribution of the different phases of the stator windings, while the phase displacement of the currents in these windings is obtained by connecting them to the three phases of the supply.

General "Single-phasing" Effects

Should an open-circuit occur in one supply line to a three-phase motor current will flow in two phases only of a wye-connected stator; whilst current will flow in all three-phase windings of a delta-connected stator, although these currents will not be equal. The magnetic fluxes will still be produced in different parts of the stator, although not of equal value. However, the fluxes will be in phase when the motor is at rest, the peak values of the flux at any point of the stator occurring at the same instant, since the supply to the motor will be a single-phase one. The motor will not be self-starting and a comparatively high current will flow in the two sound supply lines.

If the motor is lightly loaded and can be spun round by hand before switching on, it will accelerate and run in whichever direction it is started, the well known case of "single-phasing." While the motor is running, the reaction due to the induced rotor current will create a revolving magnetic field which, although not of constant value, will cause the terminal voltages of the stator to differ little from normal. The current in the two sound lines will be more than normal. If the motor is heavily loaded it will tend to groan, but the overload releases will ensure that the heavily loaded phase of a delta-connected stator is fully protected against overheating only if they are set to operate at a low value.

Open-circuits in Stator Windings

Should an open-circuit occur in one phase of wye-connected stator windings, with no other fault, current will flow in two phases only of the stator windings. The motor will not be self-starting but, if it is running, it will continue to do so unless tripped by the overload releases as a result of increased current in supply lines L_1 and L_3. In this case the voltages between each pair of stator terminals will have normal values.

If an open-circuit occurs in one phase of delta-connected stator windings, the two sound phases of the windings are connected between two different supply phases, L_2–L_1 and L_1–L_3, respectively. The peak fluxes in the sound phases will then occur at different instants so that a revolving field will be created, though not of uniform value. If the motor is not heavily loaded it will most likely be self-starting. Each supply line will carry current, though not of equal values, and correctly set overload releases should trip the starter if the motor loading is such that serious overheating of the energised windings may occur.

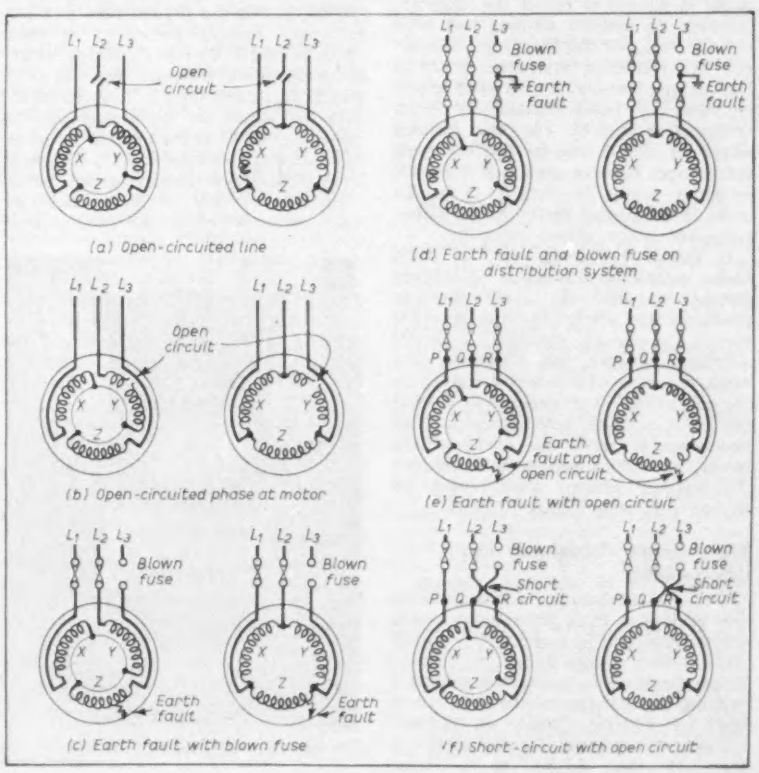
Effects of Faulty Starter Contacts or Connections

It should be appreciated that the effects of open-circuits in three-phase motors may be masked in various ways. For example, the moving contacts of a hand-operated starter frequently move back slightly, when the starter handle is released, until the hold-on catch engages, particularly if the catch is worn. The moving contacts may "lift" the fixed contacts to an appreciably less degree after the starter handle has been released and, if a fixed contact is worn or wrongly adjusted, it may open-circuit that line. The motor will be self-starting on normal load, but may run with an open-circuited line.

In the case of a hand-operated or an automatic wye-delta starter the motor may start up quite normally in the starting position, but if there is a faulty contact or connection in the running position the motor may then continue to run with an open-circuit in one phase of the stator windings. Similarly, a hand-operated or an automatic auto-transformer starter may start a motor quite normally, but leave it running with an open-circuited supply line if there is a faulty contact in the running position of the starter.

Earth Fault with Open-circuit

A fault which may sometimes be overlooked is an earth fault combined with an open-circuit. The earth faults indicated in the diagram may cause open-circuiting of the supply line by "blowing" the fuse. In this event the windings are left connected between the supply lines and earth. Since there is phase displacement between the volt-


L1 L2 L3
Open circuit
(a) Open-circuited line
Blown fuse
Earth fault
(d) Earth fault and blown fuse on distribution system
(b) Open-circuited phase at motor
Earth fault and open circuit
(e) Earth fault with open circuit
Short circuit
(c) Earth fault with blown fuse
(f) Short-circuit with open circuit

ages across these three points, the motor will probably be self-starting when switched on, particularly if it is not heavily loaded, though it may start up more slowly than normal, depending on the position of the earth fault. It is even possible that no unusual running of the motor will be noticed, though the phase currents, line currents and voltages between the motor terminals will be unequal. The currents in the two sound lines will be more than normal for the motor loading.

It may be noted that, in the rather unlikely event of an earth fault at the star point of a wye-connected stator winding, the operation of the motor will be quite normal. This fault will not "blow" a fuse, and the line currents will be equal and normal.

It is, of course, possible that an earth fault may occur on the supply side of a motor starter, "blowing" a distribution fuse. The motor may be self-starting if not heavily loaded, but the line currents and voltages at the stator terminals will not be equal. Current will flow in each supply line at the motor, and it is unlikely that the local motor fuses will "blow." The currents in the stator windings will not be equal, and the increased current in the supply lines may cause closely set overload releases to trip the starter if the motor is heavily loaded.

A somewhat similar state of affairs may result from an earth fault in conjunction with an open-circuit in the motor, or between the motor and starter. One set of conditions which were found to exist in a wye-connected motor when tested is shown at (e) in the diagram, although no unusual running had been noticed. None of the fuses had "blown" and the insulation resistance to earth from motor terminal R was satisfactory, the earth fault being indicated only from terminals P and Q. The line currents would, of course, not be equal, though the voltages between each pair of motor terminals would be normal as in the case of a similar fault in the delta-connected motor shown alongside.

It should be noted that the earth faults mentioned all result in current passing through the earth-continuity conductor the whole time the defective motors are running, creating a potential difference between this conductor and earth, the value of which will depend on the earth-fault loop impedance. Should the main earthing system have a high impedance to earth, the frame of the motor, and other apparatus bonded to the earthing system, might reach an unpleasantly high voltage to earth.

Open-circuit Combined with Short-circuit

There is another type of fault which will prevent a three-phase motor being self-starting; that is a short on a motor circuit which causes a fuse to "blow." If the fault occurs while the motor is running the current in the two sound lines will increase. Closely set overload releases may protect a motor against a fault of this nature. If a delta-connected motor is not tripped, it may burn out since, as will be seen from the diagram, phase Y of the stator windings is short-circuited, the windings being linked with flux produced by the remaining phases. The line currents will be unequal, of course, as will be the voltages between each pair of stator terminals; voltage between Q and R will, of course, be zero. It will be noted that the open-circuited line would not be revealed by a test lamp connected in turn between each supply line and earth at the starter, even when the starter is "off"; but it would be revealed by test lamps connected between the phases.

Maintenance, Protection and Testing

These faults indicate the need for periodical checking of contacts, connections and fuses, coupled with tests of the insulation resistance. In general, better protection against such faults may be afforded by using out-of-balance overload releases, which operate in the event of unbalanced line currents as well as on overload, than is afforded by plain overload releases. Detection of these types of faults may be facilitated by measurement of the resistance of each phase of the stator windings and/or measurement of the current in each supply line to the motor when running.

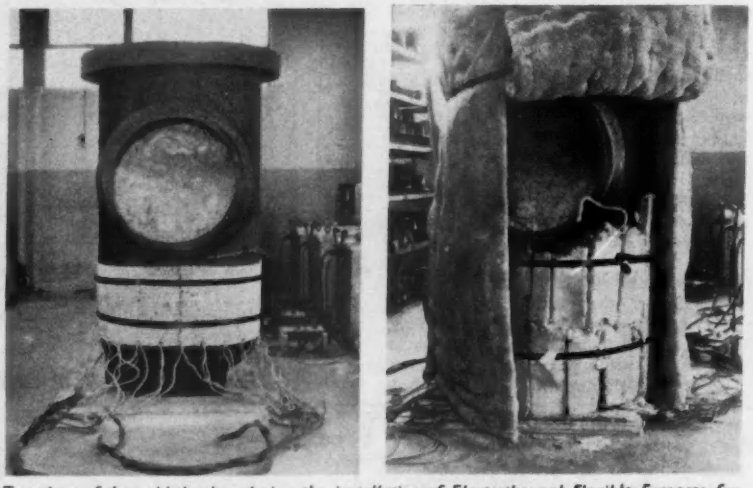
STRESS RELIEVING A VALVE CASTING

IN the manufacture of cast-steel pipeline valves of large nominal bore and designed for high pressures, the production of a single piece body casting can present difficulties, not the least of which is that of core removal after casting. The Triangle Valve Co., of Wigan, Lancs, faced with the production of 20 in. and 24 in. valves for a 600 lb/sq in. to 700 lb/sq in. pipeline, tackled the problem by having the body cast in two halves and subsequently welding them together.

Both the specification for the valves and BS 1500 call for stress relieving after welding and it was decided to adopt electrical methods using Electrothermal Flexible Furnaces, previously described in this section (page 245, 18 Aug.). The requirement in the present case was for an initial soaking period of at least 1½ hr at 600°C to 650°C, during which the temperature variation over the portion being heated must not exceed 50°C, with two hours for the temperature to rise from 300°C to the soaking temperature and not less than 1½ hr for cooling from the soaking temperature to 300°C.

Several Flexible Furnace elements were obtained which, in combination, would fit circumferentially round either the 20 in. or 24 in. casting. For the latter, three furnaces, each 15¾ in. by 35 in. and with eight circuits, were used. These were connected to three 300 A welding transformers and operated at 61 V, the maximum power demand with all at the full rating of 25 W/sq in. being 40 kW.

For thermal insulation, the upper half of each casting was filled with mineral wool and the whole supported on three ½ in. thick pieces of asbestos millboard with a further three on the top flanges. The Flexible Furnace elements are supported by steel cables from the top of the casting and are held in close contact by means of steel bands. External insulation is provided by 3 in. thick insulating blocks radiused to the approximate shape of the casting and held in place over the elements by steel bands. Finally, a metal ring on the top flange supports asbestos cloth mattresses which hang over the block insulation and are again held in position by steel bands. Six thermocouples, placed circumferentially just below the weld line, are coupled to a multi-channel chart recorder. To date some 30 treatments have been carried out with complete success.



Two views of the welded valves during the installation of Electrothermal Flexible Furnaces for stress relieving operations

NEW LITERATURE

Industrial Electronics Apparatus

by P. Van der Ploeg

A FURTHER volume in the popular Philips Technical Library series, this book does not describe circuits or design techniques for industrial electronic equipment. What it does do is to point out many of the pitfalls in design and maintenance procedure which are common. It outlines what might be termed the right attitude of mind for the maintenance engineer and also contains several valuable hints and comments on design procedure. It might have been better in this book to limit the scope to either design or maintenance procedures rather than attempt to deal with both fairly superficially. Published by Cleaver Hume, 97 pages, 8¼ in. by 5¾ in. Price 9s 6d.

Modern Network Analysis

by F. M. Reza and S. Seely

WRITTEN for the immediate post-graduate student who has not tackled the topological aspects of electrical networks, or for the final-year undergraduate giving special attention to this subject, this American textbook is a clear presentation of many of the relevant basic ideas. It splits explicitly into three parts, the first devoted to a general introduction to network analysis, introducing many of the concepts necessary to the topological approach. This section includes, for example, a brief study of the principles of matrix algebra. The second section covers classical applications of network analysis to filters and transmission lines, while the final part deals with networks under transient conditions. The book is plentifully provided with examples for calculation, for which answers are printed. Published by McGraw-Hill, 373 pages, 9 in. by 6 in. Price 77s 6d.

Principles of Illumination

by H. Cotton, M.B.E., D.SC., M.I.E.E.

THERE are remarkably few English textbooks on the subject of illuminating engineering and this, the work of Dr Cotton, is a welcome newcomer. In the preface he leaves us in no doubt as to his views on the confusion that exists in regard to the different units of luminance and which he does much to set right in chapter six.

For the rest, the subject is presented in a logical series of chapters, commencing with the basic principles of radiation, reflection and refraction and continuing with the physical mechanism of vision, colour and light distribution before dealing with photometry, modern light sources and illumination calculations. The final chapter deals, perhaps a little inadequately, with street lighting. For the student concentrating on part III of the IEE examinations this should prove the ideal reference work; illuminating engineers will also find it of value. Published by Chapman and Hall, 514 pages, 8½ in. by 5¼ in. Price 75s.

Science Masters' Handbook

by I. L. Muter, B.SC., A.M.I.E.E., A.INST.P.

STUDY of basic theory in science is aided by convincing demonstration experiments. It is the purpose of this handy publication to give details of 47 suitable experiments which can be performed with commercially available electronics equipment. Commissioned by Advance Components Ltd., it begins with a concise statement of the theory to be covered and then proceeds to descriptions of the experiments clearly set out in terms of apparatus required, connections and experimental procedure. Besides the expected experiments in electronics, there is some coverage of wave motion generally and of the physics of sound. Published by Advance Components Ltd., 124 pages, 8¼ in. by 5 in. Price 12s 6d.

Nuclear Technology for Engineers

by R. Hobart Ellis, Jnr.

THE author has produced a useful and very readable introduction to nuclear physics and modern applications of nuclear techniques for those who wish to know something of the subject but who do not require the detailed treatment of a textbook. The approach is descriptive, with mathematics kept to the minimum necessary to define nuclear terms in general use. After outlining knowledge of nuclear particles and radiation, means of detecting radiation and radiotracer technology are discussed. A large proportion of the book is devoted to the effects of radiation and how dosage can be measured. A chapter on fission and the chain reaction leads into a description of the various types of reactor. Here the treatment is necessarily superficial although the large number of types is indicated and defined. Only an outline of their operation is given and the American origins of the book become apparent from the very brief reference to Calder Hall, while Dounreay and the British civil stations are not mentioned. A final chapter gives clearly the basic ideas on nuclear fusion and plasma. Published by McGraw-Hill, 284 pages, 9 in. by 6 in. Price 74s.

The Universe of Relationships

by J. H. Reyner, B.SC.HON., D.I.C., M.I.E.E.

THIS book, written by an engineer, claims to discuss some of the more remarkable patterns revealed by science and their relationship to the greater patterns implicit in religious and esoteric teaching. The author takes us in a chatty way through the "magic" of chemistry, electron theory, our present knowledge of vibrations and a description of modern theories of scale and time. The author's intention is to show that scientific phenomena, such as the occurrence of octaves in several branches of physics, can provide the key to a reconciliation between scientific theories and religious doctrine. But while the reader is led by comfortable steps through the scientific theories, he finds himself faced with immense jumps in extending them to the conception of an overall pattern for the universe. At just these points where the author's helping hand is needed, it is conspicuously lacking, and some of the bases for the arguments advanced appear to be quite arbitrary. Perhaps the book is best regarded as illustrating the difficulties of interpreting, through cold print, human thoughts which in turn give only limited exposition to human emotions. Published by Vincent Stuart Ltd., 130 pages, 8¼ in. by 5¼ in. Price 25s.

Kempe's Engineers Year Book, 1961

ed. by C.E. Prockter, M.I.E.E., M.I.MECH.E.

THIS is the 66th edition of Kempe's and to record that it maintains its established high standard will be sufficient recommendation for most engineers. Few can have failed to consult it at some time, and it is a welcome feature of almost every technical reference library. Changes this year are mainly of detail. Two entirely rewritten chapters are those on motor vehicles and forging, while there is a rewritten section on heating and extensive revision of the entries of basic physics, the mechanics of fluids and units of measurement. Additionally, there is evidence throughout the two volumes, of detailed work to keep the year-book up to date, which includes, where necessary, new sections of previously existing chapters. Published by Morgan Bros. in two volumes, 1324 pages and 1408 pages, 6¾ in. by 4½ in. Price 87s 6d.

BOOKS RECEIVED

Direct Current Machines, by H. B. Ranson and E. T. A. Webb. General text-book at intermediate technical college level, largely non-mathematical. Published by Cleaver Hume Press Ltd., 320 pages, 7½ in. by 4¾ in. Second edition, price 21s.

Thermoelectric Materials and Devices, ed. by I. B. Cadoff and E. Miller. Collection of lectures delivered at a one-week New York University course. Covers basic principles and outline of applications. Published by Chapman and Hall, 344 pages, 9 in. by 5¾ in. Price 78s.

British Nuclear Power Stations, by R. Hammond. Popular account, but with extensive engineering details, of the first four nuclear power stations, with notes on fast reactor and thermonuclear research. Published by Macdonald and Co. (Publishers) Ltd., 182 pages, 8½ in. by 5½ in. Price 25s.

Magnetic Materials in the Electrical Industry, by P. R. Bardell. Specialist survey revised and brought up to date from 1955 edition. Published by Macdonald and Co. (Publishers) Ltd., 320 pages, 8½ in. by 5¼ in. Second edition, price 32s 6d.

Keith in Electricity, by N. Logmate. Career of student apprentice in electricity board traced in novel. Published by Chatto and Windus in their Career Books for Boys, 144 pages, 7½ in. by 4½ in. Price 8s 6d.

new products and appliances

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DESIGNED specifically for laboratory use a new range of packaged air-conditioning units have cooling capacities from 29,000 B.Th.U./hr to 54,000 B.Th.U./hr. Each unit consists of an assembly of refrigeration, heating, humidifying systems housed in a single cabinet ready for connection to the appropriate electricity and water mains. A separate discharge plenum for the conditioned air, is available, having adjustable air deflectors for both horizontal and vertical distribution. Close control of temperature and humidity over a wide range of atmospheric conditions, is claimed. *Carlyle Air Conditioning and Refrigeration Ltd., 1 King St, St. James, S.W.1.*

Unit-constructed contactors

EASE of installation and maintenance are among advantages claimed for a new range of contactors constructed on the unit principle. Ratings cover 50 A, 100 A, and 200 A for both a.c. and d.c. working, contactors for each particular rating being avaiable as a single- or multiple-pole version. If required, a multiple-pole unit may be built up from an existing single-pole unit, by the addition of further poles, using the same coil assembly. The contactors are intended for heavy duty operation under all climatic conditions and there are separate tungsten arcing contacts incorporated in the special blowout device, ensuring long life. The units are rated according to BS 775 and short-circuit tested to 31 MVA. They are said to be exceptionally quiet in operation. Extras available include auxiliary contacts and damp and dust protective or weatherproof cases. *Dewhurst and Partner Ltd., Inverness Wks, Hounslow, Middx.*

Square-wave pulse switch

HAVING a maximum overall dimension of only 2½ in., the "One-Shot" is a compact form of pulse shaping circuit for producing square-wave pulses used in control applications. It is made up of a precision, single-pole, double-throw microswitch, connected in circuit with a capacitor, resistor, magnetic core and diode, all of which are encapsulated in a single package. If the device is connected to a suitable power supply, closing the switch will produce a square-wave pulse of constant width, regardless of the speed of switching, with an amplitude of up to 180 V capable of driving a load impedance of as little as 5 ohms. A range of six units is available, having either push-button or toggle actuation, covering a pulse width range of 0·1 microseconds to 10 microseconds. *Honeywell Controls Ltd., Greenford, Middx.*

Latest EE 'fridge

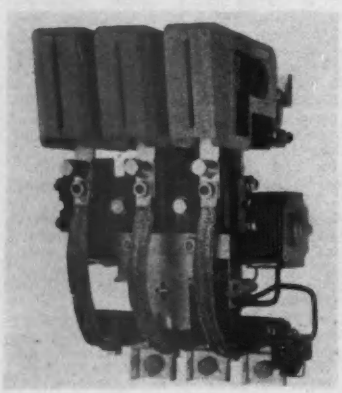
LATEST in English Electric's "Slimline" refrigerator range is a 4·1 cu ft model with a freezer claimed to store frozen food for up to three months. The new model carries on the "slimline" policy of minimum width in cabinets of square-cut design. It is finished in white or cream with a charcoal grey trim on the front of the cabinet, and has an interior two-tone colour scheme in blue. Vitreous enamelled table-top at standard 36 in. height has a raised back edge to prevent spills, and is heat and stain resistant. It can be removed so that the refrigerator fits under a working counter if required. Door, hinged on nylon bearings, opens within the width of the cabinet. Door storage provides a large dairy keeper with spring-loaded pull-down flap; two shelves for small and tall bottles, and a third shelf with removable plastic egg-holder for 15 eggs. A plastic mat protects the lower shelf from bottle scratches.

The aluminium freezer compartment is 15 in. wide by 4¼ in. deep with an insulated moulded polystyrene door, with chromium-plated handle. It provides temperatures from 15° F to below zero F, and there is a 27-cube polystyrene ice-making tray.

One large and two small adjustable shelves of white plastics-coated rod construction are provided as well as a meat drawer under the drip-tray and a glass-lidded salad crisper. When defrosting takes place, a specially moulded tray channels all water into the deep meat drawer below. The unit is a hermetically sealed compressor with automatic thermal overload protection. The new "Slimline" 41 has a 25 W automatic interior light and its cabinet is mounted on rollers. Interior control dial gives a selection of nine temperatures. Dimensions are: height 36 in., width 21 in. and depth 22¼ in. Retail price is £66 3s, including purchase tax. *English Electric Co., English Electric Hse, Strand, W.C.2.*

Battery-shaver

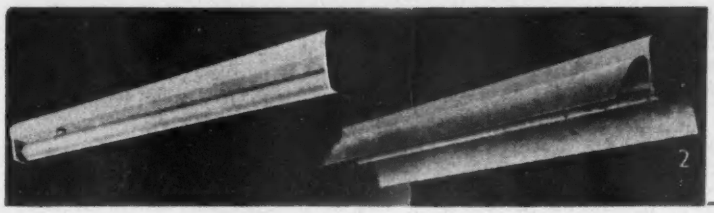
THE well-known "Philishave" rotary shaver is now available in a battery-operated model. It is identical to the original model except that two 1½ V batteries are housed within the carrying case. Flex is wound on a concealed spring-loaded spindle, and returns automatically to the storage position when a button is pressed. The batteries should provide a full month of daily shaving, at the same speed as the mains model. The two-tone polystyrene case, which measures 5½ in. by 5½ in. by 1½ in., has a mirror built into its lid. Another feature of this shaver is the ease with which it can be cleaned—the shaving head flips up instantly and the usual cleaning brush is provided. Retail price, including purchase tax, is £5 12s 6d. *Philips Electrical, Century Hse, Shaftesbury Ave, W.C.2.*



Above: Square-wave pulse switch by Honeywell Controls

Left: Dewhurst and Partner's unit-constructed contactor

Right: The latest English Electric refrigerator. A 4.1 cu ft "Slimline" at £66 3s



Crompton Parkinson's new Crompack fitting. It comprises the basic fitting (left) and any of a range of attachments which convert it for domestic, commercial, or industrial use. On the right of the picture is the fitting with reflector, simply attached by one person using screws which engage in keyhole slots. Basic fitting sells at up to £7 6s, including purchase tax

Quick-change tube fitting

FLUORESCENT fittings which can be quickly converted for use in differing surroundings by the addition of various attachments are available in the "Crompack" range. The basic fittings, available with 8 ft, 5ft and 4 ft fluorescent tubes, have lampholders integral with the smoothly formed trapezium-shaped end-plates. These are strongly moulded, provide retractable lampholder action and protect the ends of channels. Single-handed installation is simple, since only the full length backplate has to be fixed to the ceiling or suspension and, after locking open for wiring, the body of the fitting is quickly attached by screws engaging in keyhole slots. The attachments—reflectors, diffusers or frames, some of which are colour-stable "Diakon," fix directly to the channel and put no strain on the lamps.

Prices are from £3 14s 5d to £7 6s, including purchase tax for the basic "Crompack" and attachments extra. *Crompton Parkinson, Crompton Hse, Aldwych, W.C.2.*

Electronic oven

AN oven employing the microwave heating principle is among a range of Anglo-American cookers to be shown at the Ideal Home Exhibition. It comprises a large chrome-lined oven with a self-contained cooling system. The advantage of microwave cooking is its speed—six minutes for a cake, 22 seconds for eggs, 4½ minutes for a surloin steak—the cooking operation being completed with a high degree of control and an evenness impossible with normal methods. Since heat is generated in the food itself, every part of the food is cooked simultaneously and not, as in the conventional way, outside first. A further advantage of the method is that the microwaves affect only the food itself. It is possible to cook on a china plate, the plate remaining cool throughout the cooking process. Elements are switched on the moment the oven door is closed, and switched off automatically when it is opened. Rating of this oven is 8·8 kW, and its price is to be £495. The oven is part of the Thompson-Tappan range of cookers, the more "conventional" lines being no less startling in many ways. The latter were described in our issue of 27 Oct., 1960. The cookers are the result of a joint effort between John Thompson Instrument Co. and the Tappan Co. of Ohio who originated the designs in America. *John Thompson Instrument Co., Ettingshall, Wolverhampton, Staffs.*

SAFETY AND MONITORING EQUIPMENT

AMONG many roles played by electronic and electromagnetic control in industry, an important one is that of safeguarding against equipment failures. The "Protectoglo," manufactured by Honeywell Controls, is a combined amplifier and relay unit for flame-failure control of inductional combustion furnace fuel burners. The latest version can be used in conjunction with various types of flame sensor, including photo-electric, flame electrode and ultra-violet sensitive types. While the burner remains alight the sensor feeds a direct current to the grid of the amplifier triode valve, whose output is sufficient to hold in the control relay. If the flame goes out, the valve becomes biased off, the relay drops out and effectively cuts off the fuel supply to the burner. Other refinements in the equipment are the inclusion of a self-checking safe-start circuit and a timing device to allow for the purging of any accumulation of unburnt fuel before the burner is relit. Similar equipment produced by Photoelectronics is suitable for all types of fuel burner and, like the "Protectoglo," has indicator lights to show the condition of operation.

Also connected with operation of industrial furnaces is the control of smoke density to comply with the Clean Air Act. Lancashire Dynamo announce price reductions in their "Series SME.2" smoke alarm and densitometer equipment, which have been achieved by large-scale production methods. The equipment which complies with BS 2740 and BS 2811 is now available from stock.

In oil refineries and petrol filling stations safeguarding against possible explosions and contingent outbreak of fire is of vital importance. It is well known that a fruitful source of ignition of explosive vapours is that of accumulated static electric charge on unearthed tanker vehicles and discharge coupling hoses. To ensure that all equipment is properly earthed before unloading or transfer of fuel can take place, GEC have produced a transformer-relay test unit. One side of the secondary winding of the transformer is connected to earth while the other is clipped to the vehicle or fuel transferring equipment, via the operating coil of the relay. If earth continuity is satisfactory, the relay contacts close an external circuit which can be made to start a pump motor, operate a solenoid valve or switch on an indicator lamp, as required. The unit is, of course, housed in a flameproof enclosure with incoming and outgoing terminal chambers and is certified as being intrinsically safe.

For monitoring factory machinery, a photo-electric device produced by Hird-Brown Ltd., will detect changes of rotational or linear speed of mechanical components such as shafts, fans, conveyors and reciprocating parts. It can thus be used to give remote indication of stopping or slowing down of unattended machinery. The unit is housed in a dust-proof enclosure to suit industrial conditions.

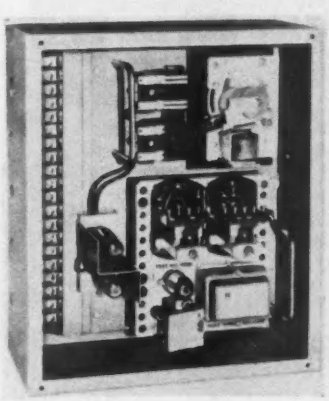
Honeywell Controls Ltd., Greenford, Middx.

Photoelectronics (M.O.M.) Ltd., Oldfields Trading Estate, Sutton, Surrey.

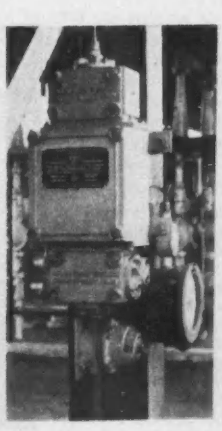
Lancashire Dynamo Electronic Products Ltd., Rugeley, Staffs.

General Electric Co. Ltd., Magnet Hse, Kingsway, W.C.2.

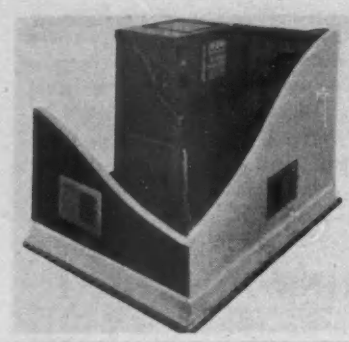
Hird-Brown Ltd., 244 Marsland Rd, Sale, Cheshire.



Left "Protectoglo" flame-failure control unit with cover removed



Right: GEC intrinsically safe transformer/relay unit for testing earth continuity of petrol-filling and oil-refinery equipment



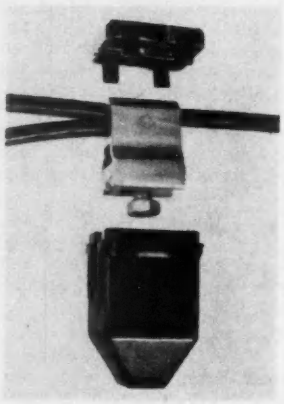
"Gnome" central heating unit fits easily into a small space to serve two or three rooms

Low-cost central heating

ILLUSTRATED left is a typical application of the "Gnome" central heating unit. In this system a central fan-heater unit humidifies air and forces it along ducts to adjacent rooms. An installation covering lower rooms and hall should cost less than £200, it is claimed. Automatic clock, which stops and starts the unit at predetermined times, room thermostat and safety switch are included. The heater was described in greater detail in our issue of 2 Feb., 1961. *Gnome Heaters (Sales), 1 Cater Bldgs, Cater St, Bradford, 1.*

Line tap shrouding

A NEW insulating shroud designed for the AWCO saddle tap for teeing-off overhead line conductors, comprises a body and press-on cap injection moulded in thermo-plastics. The material for the shroud was chosen for its ability to withstand a wide range of working temperatures and atmospheric conditions. Two sizes of shroud are available, one for the "ALT-1" tap for conductor diameters 0·177 in. to 0·366 in., the other for the "ALT-2", covering conductor diameters from 0·367 in. up to 0·558 in. *Aluminium Wire and Cable Co. Ltd., 2 St. James's Sq, S.W.1.*



Thermoplastics shroud for AWCO line taps, available in two sizes

INDUSTRIAL MEASUREMENT AND COUNTING

SEVERAL methods are available for continunous checking of dimensional tolerances of rolled or extruded products. One suitable for a wide range of materials makes use of X-rays and is employed in the "XactRAY" equipment recently introduced into this country by the American Daystrom Co. It comprises an X-ray generator, a pick-up head and conversion equipment which gives direct readings of dimensional changes referred to a pre-set nominal standard of thickness. Feature of the equipment is the incorporation of metal thickness standards available in increments of 0·0001 in. These are enclosed in a sealed chamber to be inserted into the X-ray beam by remote control when the equipment is to be calibrated with reference to a particular thickness. The X-ray beam is highly focused with the minimum of stray radiation, making it safe for operating personnel without the need for special radiological screening. Five models of the equipment are available covering thicknesses from 0·00035 in., for aluminium up to 2 in for steel plate.

Mixing and blending is another industrial process requiring continuous measurement, this time weight measurement. Electroweighers (Birmingham) Ltd. have recently marketed a system of continuous belt weighing working on a servo-loop feedback system. Briefly, a batch of material is fed on to a weighbridge from a conveyor belt, which is fed in turn by a vibratory feeder. The weighbridge incorporates a load transducer which sends signals to an electronic sampler and memory unit. This stores the load signal and after an appropriate timing interval, transmits this information to a servo-motor control which adjusts the output of the vibratory feeder to give the correct flow of material.

For counting of random objects on a conveyor or production line a new capacitance operated switch, the "pulsimitor," will operate with a capacitance charge of as little as 0·07 PF. It can count objects of all shapes and materials at rates from 12,000/min down to 5/min. Each "count" appears as an output pulse of 100 V across a 10,000 ohm valve anode circuit resistor. This can be fed into a suitable counting equipment. The unit is manufactured by Electronic Machine Co. Ltd.

Digital counting equipment suitable for use with any conventional method of count sensing (like the one mentioned above), is the "Type CBP" made by Photoelectronics. In this unit the conventional cold cathode counting tubes have been replaced by transistorised plug-in decade units. Speed of counting can be up to 3,000/sec, the count being registered by a series of neon tube indicators.

Daystrom Ltd., Gloucester.

Electroweighers (Birmingham) Ltd., Mosley St, Birmingham 12.

Electronic Machine Co. Ltd., Mayday Rd, Thornton Heath, Surrey.

Photoelectrics (M.O.M.) Ltd., Oldfields Trading Est, Sutton, Surrey.

"XactRAY" equipment for continuously checking dimensions of rolled or extruded products employs a narrow X-ray beam and requires no special radiological shielding. Five models are available, covering metal thickness range 0·00035 in. to 2 in.

TRADE PUBLICATIONS

PRESTCOLD.—Sales news and information in the "Prestcold Post," No. 24, for Feb., 1961. Six-page newsletter. Pressed Steel Co., Prestcold Division, Swansea.

BETA.—24-page catalogue and price-list of electrical accessories in the BETA range of cable markers, terminal tags, terminal blocks and phase buttons. Critchley Bros., Brimscombe, Stroud, Glos.

E.E.—Cookery Bulletin No. 15, Jan., 1961, which describes features of the cookers, Models 2032 and 2033. English Electric Co., Domestic Appliance Division, East Lancashire Rd, Liverpool 10.

BULGIN.—News Bulletin, Vol. 3, No. 34, 1961. A. F. Bulgin and Co., By-Pass Rd, Barking, Essex.

M.K.—24-page illustrated brochure entitled "A Visit to MK in 1961." Written by Lewis W. Phillips as sequel to a visit in 1936. It outlines the history of the works and describes the production, products and general organisation. M.K. Electric Ltd., Shrubbery Rd, Edmonton, N.9.

E.E.—"Abridged Valve Data," Jan., 1961. 38 pages of quick reference information with side index. English Electric Valve Co., Chelmsford.

FERRANTI.—32-page brochure giving full technical description of the Pegasus 2 computer system. List DC44, Dec., 1960. Ferranti Ltd., Computer Department, 68-71 Newman St, W.1.

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Wax Tank Heating

THE problem was to achieve a tight control of temperature on a wax tank of a paper coating machine with paper speeds of 150-500 ft/min.

Other wax tanks in the factory were electrically and steam heated with temperature control by thermostats, energy regulators ("simmerstats") and motorised valves.

The electrical loading required to maintain a temperature in the region of 200° F with high paper web speeds is approximately 18 kW and, by various methods, we managed to get a differential of 5° F (±2½°). This is normally satisfactory. In the case under consideration, however, a differential of only 1° F was required and one had to bear in mind the effects of latent heat, temperature lag when the source of heat was removed or switched off and the delay in rising and falling temperatures with high paper speeds. The following method was ultimately developed and has proved to be highly successful.

A 200-gallon tank was installed adjacent to the machine and filled with mineral oil. Heating of the oil is by low wattage heaters to a total loading of 18 kW, these being of the immersion type. Thermostatic control of oil temperature ensures that this is always about 10° F above that required in the wax tank which is provided with false sides and bottom to form a jacket through which the hot oil is pumped. The circulating pump is, in turn, controlled by a sensitive thermostat in the wax tank through suitable relays and contactors. The thermostat differential is, in fact, only 0·2° F.

By this layout we are able to control the wax temperature to well within the required limits. Agitation of the oil by pumping avoids the formation of hot spots and it has been found that the thermal capacity of the arrangement is sufficient to serve two machines. It is, therefore, apparent that the arrangement contributes to lower heating demand (loading) per machine.

I have omitted reference to the usual safeguards and controls which are a normal part of wax heating equipment with volatile and inflammable constituents but these, of course, are included in the installation.—*E. J. Last.*

Switch in Neutral

TROUBLE was being experienced with a fluorescent lighting fitting installed over the staircase of a house. This had been fixed by the householder and his complaint was that the fluorescent tube continued to give light in the form of a faint flickering glow after it had been switched off. The effect appeared ghostly in total darkness and it was said that it disturbed the children in the adjacent bedrooms.

Investigation soon disclosed that though care had been taken to earth the casing of the fitting as instructions called for, the single-pole switch controlling the position was in the neutral, instead of the live, feed. As can be seen from the first circuit, this resulted in a very small capacitative current flow from the live feed through choke and power factor

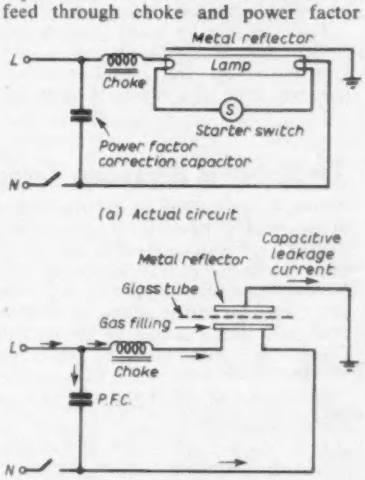


Fig. 1, above, shows the passage of leakage current from the live main to earth with the switch in the neutral. Fig. 2, below, shows the equivalent capacitor circuit

capacitor to the earth screen via the tube electrodes, vapour column, and glass envelope.

The small discharge current was sufficient to cause the tube to glow faintly and, as a matter of interest, the magnitude of the current was measured and found to be only a few micro-amperes. Reversal of the live and neutral connections at the fuse board corrected the trouble. Fig. 2 shows the equivalent circuit with the capacity leakage paths represented by capacitors. The earthed plate is formed by the metal reflector and the other plate by the lamp electrodes and conducting vapour filling. The dielectric of the capacitor is represented by the glass tube and intervening air space. With the control switch in the neutral feed, supply voltage is permanently applied across the capacitor, passing sufficient current to cause the phosphor to glow faintly.—*D.C.*

Sensitive Relay Problem

ON an aircraft circuit close differential control of temperature on a windscreen heating circuit was effected by a device incorporating a sensitive polarised relay, power relay and transformer/rectifier. The design, of American origin and manufacture, had been satisfactory over a large number of deliveries until one batch was received in which a large proportion were unable to achieve the required differential sensitivity. No matter what adjustments were made in the test-room, the performance was inconsistent and unreliable. Unfortunately, no other spares were available and aircraft were being held up in production until the units were installed.

There was no help for it. A trans-atlantic phone call was made to the makers and a long conversation ensued. Every possible adjustment was suggested but they had all been tried. It seemed an impasse. Suddenly a thought struck the British engineer on the line. "Is it not possible that the power relay field is affecting the closely located sensitive polarised relay?" he asked.

There was a moment's tense silence from the other end and then "Of course it does, but the effect should be to increase, rather than to decrease, the stability. Try reversing the connections on the power relay."

And, as it happened, that was the solution.—*Ion.*

Bit of a Smell

IT wasn't really an electrical fault but it concerned a lighting fitting. The visit to the house had been on an entirely different matter which, having been satisfactorily resolved, had put the householder in a good humour. Just before the engineer left, he and the lady of the house had got into a conversation in the course of which she said that she was now awaiting the visit of the plumbers who were going to pull her nice bathroom to pieces to find a smell which was coming from the drains. Curiously, it was only in that room and it was strongest at night after someone had been bathing.

A thought struck the engineer and he asked to see the bathroom. One glance was sufficient. "Madam," he said, "you don't need the plumber. There is the trouble." And he pointed to the plastic lighting fitting of moulded urea-formaldehyde in which a far too large lamp bulb had been fitted. The casing was heavily discoloured and charred by the heat.

Decomposing urea-formaldehyde does have a smell like a drain.—*C.W.*

News of the Week

TWO MORE BOARDS RAISE TARIFFS

April increase in E. Midlands and S. Western areas

NEWS of increased tariffs now comes from two more electricity boards—the East Midlands and the South Western Boards. The first named will have to meet increased costs amounting to some £2½ million annually, it is stated. In the EMEB domestic block tariff the primary rate remains 6d/unit, but the number at that rate is raised by one unit/room/quarter up to ten rooms and for ten to 15 rooms the assessment is reduced by three units/room. But the running charge is up from 1d to 1·15d. The farms tariff has similar changes, with the number of units in the first block increased by ten to 120/quarter for small farms; by 20 to 220/quarter for medium farms; and by 30 to 290/quarter for large farms.

For commercial consumers, the flat rate for lighting is raised ¼d to 6½d; for other purposes from 1·85d to 2d; and in the block tariff the secondary rate is increased ¼d to 2¼d, with the running charge also up from 1d/unit to 1·15d/unit. The Board are also introducing an additional charge for prepayment meters in the form of a surcharge of 1d on units used in the first block up to a maximum of 60 units/quarter. In the industrial tariffs the running charge remains unchanged, except for coal price adjustment, but the kVA charges/m.d. are raised to give an overall increase of between 5% and 8%. The running charge of the industrial block tariff is also 0·15d higher. All these changes operate from 1 April next, which is also the operative day for the South Western Board's increases.

In that Board's domestic and farm tariffs an extra ¼d is put on the unit prices in the second block and the running rate bringing the latter up to 1¼d p.u. The first block of units remains at 7d, but in houses of nine rooms or more, units charged at 7d and 2½d will be reduced by 20 to 70 units.

There is no change in the off-peak rate, but the flat rate tariff, hitherto only applicable to the larger towns, will now be available throughout the area.

These changes are made to meet extra costs estimated by the Board at over £1m in a full year. Similar news is expected from the North Western EB.

Electricity in Hazardous Areas

THE London meeting of the Association of Supervising Electrical Engineers next Tuesday, 21 February, is being thrown open to non-member engineers and technicians. Scheduled for 6.30 p.m. at the IEE building, Savoy Place, it will be concerned with a lecture by Mr W. J. F. Cocks, head of the electrical department of Shell-Mex and B.P. Ltd, entitled "Operation of Electrical Plant in Hazardous Areas."

USKMOUTH "B" COMMISSIONED

THE first of three 120 MW turbo-alternators and its associated boiler, at Uskmouth "B" power station, South Wales Division of the CEGB, was put on load last Sunday. The turbo-alternators are being supplied by English Electric Co. and the boilers by Babcock and Wilcox Ltd. Steam conditions at the boiler stop valves are 1,600 lb/s.i.g. and 1,010°F, reheating 785 klb/hr from 697°F to 1,005°F at 391 lb/s.i.g. At the t.s.v., steam conditions are 1,500 lb/s.i.g. at 1,000°F with reheat at 375 lb/s.i.g. and 1,000°F. The new "B" station has been built adjacent to Uskmouth "A" which has had six 60 MW GEC sets in operation since 1956.

LOCH AWE CONTRACTS

CONTRACTS worth £2¼ million for work on the Loch Awe hydro-electric scheme have been awarded to the Mitchell Construction Co. by the North of Scotland Hydro-Electric Board. The orders include the construction of a 4¼-mile long access road, a 2¼-mile tunnel, an underground power station and aqueducts. Under previous contracts the company are building a dam, a river barrage and the foundations of another power station in the scheme which, when completed, will add some 440 MW to the Board's generating capacity.

Lighting in the new Piccadilly Circus

MORE imaginative advertisement signs are envisaged by Sir William Holford as being an integral part of his new tentative proposals for the development of Piccadilly Circus which he outlined at County Hall, last Friday. He is opposed to an earlier scheme for what he termed a "tall blackboard" of advertisements, and has suggested more horizontal treatment which the many façades at different levels under his plan would make interesting. Sir William feels that the more solid lighting should be kept at low level, while towards the sky there could be more pyrotechnic effects, animated and possibly 3D displays. So far, London illuminations were not nearly as interesting or amusing as they could be, in his view, and the new scheme suggests an extension and improvement of the lights as part of the major rebuilding proposed for the area.

OPPOSITION TO GLEN NEVIS SCHEME

REPRESENTATIONS concerning the Glen Nevis hydro-electric scheme of the North of Scotland Hydro-Electric Board are being considered and it was hoped to make a statement shortly. This was stated by the Secretary of State for Scotland at Question Time in the Commons on Tuesday in answer to questions as to whether any decision had been taken to hold an inquiry into the proposals (to which we referred on 13 Oct. last). He was also asked if he would make a statement about future hydro-electric schemes, but evaded this point while adding that representations made against the scheme had been communicated to the North of Scotland Hydro-Electric Board.

The Scottish Landowners' Federation have reiterated their demand for a public inquiry into the proposed Glen Nevis scheme of the North of Scotland Hydro-Electric Board. But Inverness Town Council last week decided to resist the efforts of Aims of Industry and other similar organisations to have an inquiry into the need for further hydro-electric schemes in the Highlands. The Town Council also agreed unanimously to oppose any attempt to interfere with the constitution of the Board and amalgamate it with the South of Scotland Board. Councillor K. P. MacKenzie declared that the attempt at amalgamation "was a disgraceful idea."

JERSEY TARIFFS UP

INCREASED tariffs to cover rises in working costs and interest charges on new capital are being put into operation from 1 May by the Jersey Electricity Co. The primary block rate is raised 1d to 7d/unit, but prices of 1·7d/unit and 1·4d/unit in the other blocks remain. For domestic consumers the assessment, based on the number of rooms, is increased by about 20%.

Large Claims Face Price Fixers

Aftermath of U.S. Anti-Trust Case

CLAIMS for damages from alleged overcharging against US electrical manufacturers convicted in the price fixing conspiracy case look like running into millions of dollars. This became clear when the Attorney General, Mr Robert Kennedy announced after the case ended last week that the Federal Government would sue on behalf of at least 20 federal agencies. The first complaint is expected to be filed within two months. Several large state and city authorities are also preparing claims and a large number of private electricity utilities are taking legal advice to determine their course of action. The 29 companies convicted in the largest-ever anti-trust case comprise the greater part of the American heavy electrical equipment industry. The total of all sales affected over the entire period of the price ring is estimated at $7,000 million, of which 20% was sold to various public authorities. By law, the Federal Government may sue for the actual damages caused by anti-trust violations, and all others may sue for triple damages. But the Government, really seeking its pound of flesh, is contemplating suits under the False Claims Act which would enable it to claim double instead of single damages.

The case itself ended dolefully enough for the manufacturers, with fines totalling $1.8 million dollars and the humiliation of having seven top executives imprisoned for 30 days and a further five given suspended sentences of 30 days and placed on probation for five years. And now the magnitude of the damages threats seems to have the major companies really worried.

The largest of them all, American General Electric and Westinghouse, are seeking out-of-court settlements eliminating triple claims. GE say they will vigorously defend triple damage suits, but the New York and San Francisco city authorities are already pressing triple claims. Against this background, Wall St lost no time in marking down electrical shares.

Nor is this all the manufacturers have to contend with. Prices in the U.S. for electrical generating, transmission and distribution equipment have been unstable and generally moving down for months. While the timing of the downtrend did coincide with the anti-trust investigators getting hot on the trail towards the middle of last year, opinion among major American purchasing officers is divided as to whether overcapacity and general business slackness or price ring busting played the greater part in the slump. One bright spot is that the position will not necessarily deteriorate further now that the case has ended, because most of the market effects have already worked themselves out. Foreign bidders for US tenders are no longer automatically undercutting domestic quotes.

American anti-trust law is still based on the Sherman Act of 1890. The effectiveness of the law, which goes a good deal further than English law and can even break up the monopolistic mergers, has waxed and waned with various Administrations. The Eisenhower Administration proved unexpectedly zealous trust-busters, trebling the number of investigations in the past years. There is no evidence that things are going to be much different under President Kennedy. American business, far beyond the confines of the electrical industry, is bound to feel a little jittery just now.

U.S. Accessory Firm Here

THE old-established American wiring accessories concern, Harvey-Hubbell Inc., of Bridgeport, Connecticutt, have formed a subsidiary in this country. Under the title of Harvey Hubbell Ltd., the firm is operating from Knoll Road, Camberley, Surrey, and is now assembling certain products, but eventually it is planned to open a factory here. The aim is to concentrate in industrial plugs and sockets for use on up to 600 V, and catalogues are in preparation. Apart from supplying items direct to manufacturers, it is proposed to trade through wholesalers. Directors of the British concern are Mr Harvey Hubbell, Mr G. R. Weppler (both of USA), Mr A. L. Underwood (Britain), with Mr K. M. Cox as sales director.

ANOTHER CRANE/LINE ACCIDENT

ARISING out of another crane and power line accident, damages totalling £9,600 were awarded in the Scottish Court of Session last week to the widow and family of a man who was killed in the accident. He had been engaged on demolishing an old bridge over the river at Seatwell, Contin, by Strathpeffer, when the crane jib touched h.v. transmission lines spanning the river. The defendants, J. Baxter and Sons (Contractors) and Reed and Mallik, who were sued for a total of £12,500, admitted liability, but contested the action on the ground that the sums sued for were excessive.

Three More Acquisitions

HAVING acquired 83% of the capital of Electro Dynamic Construction Co. Ltd., of St. Mary Cray, Kent, Amalgamated Industries (formerly Knitmaster Holdings) propose shortly to make an offer for the balance. The deal involves about £600,000, which is being provided by bankers, but will soon be funded by the realisation of existing properties in the Amalgamated Industries group. Electro Dynamic Construction Co. was incorporated in 1920. Profits for the year ended 28 Feb. last are about £105,000, and net assets are estimated not less than £700,000.

Extending its activities in Australia, Metal Industries Ltd. have acquired all the share capital of Alcol Holdings Pty. Ltd., a New South Wales electrical engineering group, who own Alan Colless Pty. Ltd. and Design Control and Manufacturing Pty. Ltd. The purchase consideration is £30,000 new ordinary stock in MI. Alan Colless already sell the Brookhirst Igranic products in Australia, while Design Control and Manufacturing make control gear based on components made by Brookhirst Igranic.

Cannon Electric Co. (Los Angeles) have acquired all the capital of Cannon Electric of Great Britain, in which they had a 25% holding. The latter firm deal in plug and socket connectors.

Actions against the E.T.U.

BECAUSE of the enormous amount of work involved in examining thousands of documents, the legal action against the chief officers of the Electrical Trades' Union, alleging ballot rigging in the election of Mr Frank Haxell as general secretary, has been deferred from 27 Feb. until the Easter law term, which starts on 11 April. This deferment was granted in the High Court on Monday after Mr N. Lawson, Q.C., for the two plaintiffs, Mr J. T. Byrne and Mr F. Chapple, had alleged that in the towns known to be non-Communist, votes were posted in fake envelopes by a man sent round the country.

A MEMBER of the Putney branch of the Electrical Trades Union, Mr T. Odlin, has instituted proceedings against the union and its four chief officers, claiming that they have used union funds contrary to its rules. He alleges that union funds have been misapplied over a long period and asks for an account of payments made between 1954 and 1960, contrary to provisions of the rules. He asks that the four officers should repay all moneys found to have been paid without authority of the rules and seeks an injunction restraining them from using funds except in accordance with the rules.

Southend line this year

EASTERN Region of British Railways expect to complete electrification of the Fenchurch St to Southend line by the end of this year, but not in time for summer as was previously planned. Work began on the scheme 4½ years ago, but delays began last summer.

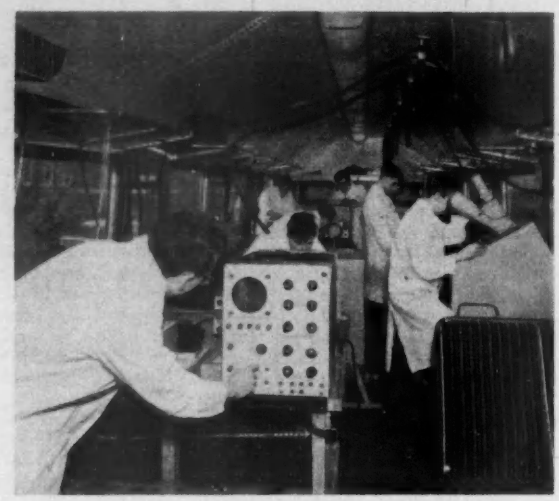
Ceylon restrictions

CEYLON has imposed stiffer import restrictions on domestic electric appliances and refrigerators, in addition to raising tariffs. Import licences issued before 25 Jan have been cancelled. The Ceylon Government has confirmed that Commonwealth preference will be retained, so the new preferential tariff on electrical appliances in general is 45% (as we reported on 2 Feb., the new non-preferential rate is 55%). On refrigerators the new preferential rate is 70%, against 75% non-preferential. GATT is discussing the moves.

Labour Costs in Hong Kong

WAGES and working hours in Hong Kong in the manufacture of small electric goods were the subject of a question in the House of Commons last week. Mr F. Allaun (MP for Salford East) alleged that "thanks to sweated labour," goods such as electrical lampholders were being sold in the UK at 7s 6d/dozen including sea transport. He said the cheapest possible price for Lancashire manufacture was 12s 6d/dozen. The Under Secretary of State for the Colonies said that in the electrical goods industry just under ten hours' work was done every day by men and women and, so far as could be estimated, wages rose by just over 15% last year in Hong Kong.

MOBILE LABORATORY ON CHINGFORD LINE



The interior of the laboratory train's motor coach (the central coach) stripped of most of the seats and fitted with instruments to measure voltages and currents throughout the train's traction system from pantograph to motors

GENERAL Electric Co. have converted one of the electric trains on the Liverpool St to North East London suburban line into a mobile laboratory to track down teething troubles on the dual-voltage system. Although the trains ran without a hitch for thousands of miles of trials at 25 kV before the service was inaugurated in November, breakdowns of motor insulation and supply rectifiers soon occurred under actual working conditions, which involved a substantial amount of running on 6,250 V. Most of the trains have been modified and are now back in service.

The trains back in service are working well, but GEC are apparently taking no chances. The laboratory train has just started running between Enfield Town and Chingford via Hackney Downs, where disruption of main-line services is avoided. The three-car testing unit is coupled to another to simulate normal six-car working and tests are run by night as well as by day. High-speed cathode-ray oscilloscopes show GEC's 11-man test team—headed by Mr D. L. Rawle—what is happening in the circuits.

Objection to no open tendering

AN invitation to the North Western Electricity Board to quote for electrical work in 66 new houses on the Burnley Road site, without seeking other tenders, was criticised at the recent meeting of Blackburn Town Council. The Housing Committee sought confirmation of the borough engineer's action in dispensing with the requirements of standing orders as to advertisements for such works, and asked for confirmation of the Board's tender of £8,730. Raising the matter, Councillor G. Gillibrand said he refused to believe that there were no private contractors capable of dealing with the work.

Chairman of the Housing Committee, Councillor F. Jamieson, explained that the Board were doing a considerable amount of work for the Corporation in an experimental capacity, such as floor heating. It was because the work was still in an experimental stage that the Board had been invited to tender for the Burnley Road scheme. The figure quoted was based on specifications set by the borough engineer's department.

The minutes of the Committee were confirmed.

OFFICIAL PUBLICATIONS

Flammable Gases. Technical Information Sheet 3015. Fire Protection Association.

BS 443. Galvanised coatings on wire. 6s.

For Los Angeles

This line of units at the Blackwood, Mon, factory of South Wales Switchgear Ltd. is part of a contract for the supply of 365 oil circuit-breakers now in process of delivery to the city of Los Angeles. With a short-circuit rating of 150 MVA at 5 kV, the units are designed to US Standards for installation in the city network, and the Los Angeles authorities have conducted field tests on the equipment

Transformer orders

C. A. PARSONS have received a £½ million order from the CEGB for four 180 MVA transformers for Elland substation, Yorks. These transformers are three-phase auto-transformers for interconnecting the 275 kV and 132 kV grid systems. Cooling is of the ON/OFB type and each unit will be fitted with three single-phase linear resistor tap-changers giving plus and minus 15% variation in 18 steps of 1·67% at the 132 kV terminal.

GRESHAM Transformers Ltd. report that their factory at Hanworth, Middx, is fully occupied, including the extension made in 1960. A recent order is for £45,000 worth of special purpose transformers for Germany, incorporating a special cooling technique designed by Gresham engineers. Further transformers are being supplied for the extensions at Gatwick Airport.

INDUSTRY SLACKENS PACE

LESS optimism and a tendency for a shortage of orders to supersede shortage of skilled labour as the main curb on production have been shown up by the Federation of British Industries' latest questionnaire among 752 company leaders. Forty-four per cent of the industrialists were less optimistic than four months ago, and only 9% more optimistic. New orders have fallen short of forecasts and output has shown a distinct decline. Brighter spots are that capital equipment orders are still rising, new export orders as a whole show no change, and export deliveries are up. A shortening of order books is attributed mainly to consumer goods in the home market.

One of the most disturbing factors is the most decided rise in unit costs since the questionnaires began three years ago. Higher hourly wages in the absence of any general rise in output to cushion the effects seem to be the main element, but there have also been increases in the cost of some materials and fuels.

Despite a trend towards rising selling prices, these conditions are having their effect on profit margins, with 49% of the firms indicating lower margins than four months ago and only 7% higher.

In line with the general picture of a gradually deteriorating business climate, surplus capacity was reported by slightly more firms than four months ago—45% against 41%—and stocks of finished goods and raw materials continued to rise.

£3,950 More Damages against E.B.N.I.

ANOTHER £3,950 has been awarded against the Electricity Board for Northern Ireland in the Ulster High Court in settlement of a claim for damages following the death of a man. The Board was sued by the man's wife. As a linesman employed by the Board he was sawing a branch from a tree and was descending a ladder when the branch fell to the ground, striking him and causing him to fall. He received injuries from which he died the same day.

Higher Education Inquiry Committee named

COMPOSITION of the committee of inquiry into higher education, under the chairmanship of Prof Lord Roberts, has now been announced. The other 11 members of the Committee named include Sir David Anderson, formerly director of the Royal Technical College of Science and Technology, Glasgow; Sir Edward Herbert, chairman of the governing body of Loughborough College of Technology; and Sir Patrick Linstead, rector of the Imperial College of Science and Technology. We reported on 29 Dec. last the Prime Minister's decision to set up the Committee.

E.E.U.A. Objectives

OBJECTIVES of the Engineering Equipment Users' Association are set out in a short pamphlet now available from the General Secretary, 20 Grosvenor Gardens, S.W.1. It notes the principal objects of the Association as to assist members in standardisation policy for engineering material and equipment and consumable stores; to promote the preparation and adoption of specification for such materials, etc.; to gather and summarise information on such material, etc. The leaflet emphasises that the work of the Association is entirely complementary to that of BSI with whom close collaboration is always maintained. EEUA does not publish standards, but submit drafts to manufacturing interests or to BSI. There are at present 12 members, primarily drawn from the chemical industry, and membership is confined to companies and other bodies who are predominantly users rather than manufacturers of engineering products.

Barking Showroom

LONDON Electricity Board have modernised yet another showroom—this time at Barking. Infra-red heating lamps on the outside of one window, for the comfort of window-shoppers, and an automatic lamp-vending machine are features of the renovated premises. The interior has a suspended ceiling with a midnight blue backing and incorporates illuminated sections contrasting with panels housing adjustable spotlights.

THE QUEEN AT WARSAK

During her tour of Pakistan last week HM the Queen and Prince Philip visited the Warsak multi-purpose project. The dam retains the waters of the Kabul river 26 miles south-east of the Afghan border. In addition to providing water for irrigation, the first phase generating station has four 40 MW sets, but there are plans for two more similar machines to be added. The scheme has been carried out with the Canadian Government who provided much of the equipment in addition to a number of technicians

Above, the Queen is seen walking with the Governor of West Pakistan along the Warsak dam. Right, is a general view of the sluices of the dam

Floor-warming Design

LAST week the Electrical Floor-warming Association held a meeting under the chairmanship of Mr R. F. Weaire at which, aspects of waterproof membranes in relation to floor-warming systems were discussed. Questions were answered by a panel, including representatives of the following: Berry Wiggins and Co. Ltd., British Visqueen Ltd., National Coal Board, The Natural Asphalte Mine-owners' and Manufacturers' Council, Plycol Ltd., RIW Protective Products Co. Ltd. and Tretol Ltd.

THIN MAGNETIC FILM

MAGNETIC properties of thin films for use in electronic computing devices were discussed last week in a lecture by Mr E. M. Bradley delivered to the Measurement and Electronic Section of the IEE. The important difference in ferromagnetic behaviour between the bulk material and some thin films is that in a specially prepared film the electron spins contributing to the magnetisation can be made to rotate coherently rather than sequentially as in a domain-wall-motion process. The coherent-rotation process can be described with good accuracy by a simple model and can under certain circumstances be a very fast process. Both these properties are exploited in computer storage devices using thin magnetic films.

It has been found that the magnetisation-reversal process in small isolated areas of film of a size required for use in a computer store is not sufficiently coherent for a useful device to be made; this is thought to arise from the presence of edge domains. However, if the element area is selected from a large sheet by means of localised magnetic fields it has been found possible to obtain sufficiently coherent rotation. The localised magnetic field may be conveniently generated by passing a current through a strip line very close to the film.

Several modes of operation exploiting the fast coherent-rotation process are possible, all of which depend on control of the direction of the easy magnetic axis over the area of the film but do not depend upon accurate control of easy direction coercivity.

Sayings OF THE WEEK

"I mistrust this argument one hears so often, that 'stop-start-go' is the cause of all troubles." . . . LORD COBBOLD, Governor of the Bank of England, talking on credit policy, at the Institute of Bankers in Scotland dinner.

"I believe a healthy home trade on which our export trade depends can only be built up by resale price maintenance." . . . MR T. A. JOY, general manager, Army and Navy Stores Ltd., at British Institute of Management conference on retail management.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, February 14

	£ per ton	Weekly change £
COPPER, standard class A (settlement)	223½	+1¾
" (3 months)	224½	+1½
LEAD, refined pig, 99·97% purity (cash)	66	+1
" (3 months)	67	+1
TIN, refined, min. 99·75% purity (settlement)	790½	+2½
(3 months)	794	+4
ALUMINIUM, ingots 99·99·5%	186	—
" wire bars (4×4×54")	192½	—
BRASS Strip 63/37	199½	+3½
SILVER (Troy oz)	79⅝d	—

	£ per ton	Weekly change £
ZINC, virgin, min. 98% purity (cash)	84	+3
" (3 months)	83	+2½
RUBBER, per lb.		
No. 1, RSS, spot	24½d	+⅛d
c.i.f. basis, ports, April	24⅛d	+⅛d
ARMOURING:		
Galv. Steel Wire (0·104 in.)	66½	−1½
Mild Steel Tape (0·04 in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	69	—
AMERICAN PRICES:		
Copper, electrolytic (per lb)	29c	—
Lead, (New York)	11c	—

* *Tape Price, now on average, includes varnishing*

TV FACTORY RESUMES FIVE-DAY WEEK

THORN'S Ferguson television factory at Enfield restored full-time working this week after only two weeks of three-day working. There are also reports from South Wales that TV firms there, which have been on short time for months, expect to resume five-day working within the next few weeks. There is still overcapacity in the industry, but surplus stocks have begun to diminish at last.

No M.I.T. Here

THERE is no Government intention of setting up a technical university like Massachusetts Institute of Technology, Sir Edward Boyle (Financial Secretary to the Treasury) told the House of Commons last week. Answering Mr D. L. Donnelly, M.P., he said the Government's policy was to look to existing universities and colleges of technology to set a pattern for development.

News in Brief

The floodlighting of playing fields in Glasgow Green was discussed in the City Chambers last week under the chairmanship of the Lord Provost, Mrs Jean Roberts.

Fuel and Power is scheduled as a subject for a House of Commons debate on Monday next, 20 Feb.

Pressure testing of the 100 ft high pressure vessel at Hinkley Point nuclear power station is scheduled to take place next week-end.

The first automatically operated level crossing barriers to be installed in Great Britain was put into operation at Spath level crossing, near Uttoxeter, last week.

Blackburn Electronics Ltd. have received orders for data logging equipment for Belgium and Iran.

A total of 224 entries have been received for the design competition organised by the Electrical Sign Manufacturers' Association. Name of the winners will be announced on 22 Feb.

UPGRADE DESIGN OFFICE, says Sir Harold Bishop

THE electrical industry could only live by growing, but doubts whether its leaders were sufficiently aware of the need for spending large sums on research and technical education if they were to survive in a fiercely competitive world were expressed by Sir Harold Bishop, BBC director of engineering, at the annual dinner of the Ipswich and District Electrical Association. He also wondered if the technicians "in their electronic towers" realised the economic problems facing industry on which their livelihood depended. There was need for a greater recognition in industry of the importance of design, and he considered the elevation of the status of the design office might go a long way in fighting the fierce competition with which the industry in general was faced.

At the Ipswich and District Electrical Association's annual dinner, left to right: the Mayor of Ipswich, Ald P. J. Fowler, Mr H. V. Pugh (president), Sir Harold Bishop, Mr R. L. Thurlow (chairman), and Sir Charles Westlake

Company Activities

OPTIMISM prevails. Nothing of substance has yet occurred in the economic background to suggest that the country is other than floundering along in a sad state of internal "squeeze" and external payments imbalance—and yet here last week we witness this "devil-may-care" performance by stock markets which pushed the *Financial Times* industrial Ordinary share index further ahead to 321·0.

Not only have small investors again been active as buyers, but the institutions too have been taking stock off the market, all thus demonstrating their fairly unshakable faith in the continuing cult of the Equity. And, of course, there can be very little doubt about the eventual benefit which can come the way of long term investors. We had, for example, Mr Roy Thomson, the newspaper magnate, voicing the view at last week's meeting of the Wider Share Ownership Committee—"Have Equities and borrow money.... You buy them and you make money...." All the money he had been able to accumulate had been through the shares he had held!

Some tidy short-term profits too have been made in recent weeks in the electrical market. Since the beginning of 1961, I see, Berry's Electric Magicoal have come up from the equivalent of 33s 6d to around a current 40s 6d; Colvern, which started out the year at 57s has recently been up to 65s 6d although last week it encountered further profit-taking which cooled the shares back to 62s 6d. Birmingham Sound Reproducers, also, which still has heavy order books for its "Monarch" record changer, have raced up from 31s 4½d to 36s 3d—1s 3d of the rise gained last week. Those who bought Dimplex of heater fame at 47s 9d in early January now see their shares up to 62s 9d, another which gained 1s 6d last week. Holders of International Computers and Tabulators will have no complaint with the 15s a share rise to 76s since 1960 was left behind. So it was very difficult not to be enthusiastic in this world of the Equity.

Electrical shares continued last week to put on a generally good display. News that Thorn Electrical is again starting up full-time working on the Ferguson TV assembly lines after only a fortnight of three-day week working brought the shares up from 48s 3d to 49s 9d. In sympathy, Ultra Electric saw its 5s Ordinary shares boosted 2s to 16s 1½d while Radio and Allied Holdings, who make the Sobell and McMichael sets, put on 1s 6d to 23s. In front of the interim, Crabtree moved up from 28s 6d to 33s 9d and English Electric, too, with the final due were 9d dearer at 34s 3d. Hoover's "A" shares for like reason edged up from 10½d to 43s 4½d.

It seems, however, that there always has to be an exception and this was well and truly provided by Hilger and Watts, the scientific and electrical instrument makers. Chairman Mr G. Whipple announced an almost halved group profit before tax for the year ended 30 Sept., 1960, at £122,081 against £235,960 previously. The fall was due mainly to delays in achieving certain planned programmes and to increased costs which could not be recovered by advances in prices until after the year end. Happily, the total dividend of 15% is as forecast —2½ points up on 1958-59—while the order book is now nearly 40% higher than a year ago. Dealers, nonetheless, slashed the 5s Ordinary shares from 37s 9d to 29s on the first news, although later recovery assisted them back to 34s 9d.

Against the rather sturdy performance of the electrical market last week, Hilger and Watts reminds us that any too complacent, "Money-for-jam" view of share buying can be sometimes salutarily jolted by the occasional surprise and full shock treatment.—*From our City Correspondent.*

Electronic Rentals and General Holdings

This concern has just completed the purchase of all the shares of two more companies—G. A. Hubbard, TV and electrical appliance retailers, and its associated finance firm, Eastern Commerce Credits. Purchase consideration was £37,500 made up in £6,000 cash plus 160,000 1s shares. There is to be a rights issue of 1 million 1s Ordinary shares on a one-for-six basis, but the price of these had not been fixed earlier this week. The board of directors expect to follow the 10% interim dividend for the year to 31 March with a final of 10% on the larger capital.

General Cable Manufacturing Co.

The serious loss sustained on the year ended 30 Sept. last was anticipated in view of the "jungle warfare" prevalent in cable prices, but Mr C. W. K. Pantlin, chairman, is hopeful that the improving trend in the power cable business will soon also extend into the rubber and plastic cable side. The latter section, he reports, is lagging behind in its attempt at recovery. No decisive turning point has yet been reached although there are grounds for hoping that, despite the more complex problems, the concensus of opinion will stimulate realistic views and thereby restore that section of the industry to an economic basis. The Britannic Co., which concentrates on power cables, is moving out of the conditions which so seriously damaged its results in the past year. It seems that the worst part of the storm is over, and the uneconomic situation may not remain stable for very much longer. He hopes to be able to report progress in this matter with the company's current half-year's trading results.

Hilger and Watts Ltd.

A final dividend of 10% makes 15% on the increased capital for the year ended 30 Sept. last, as forecast. But group profit is almost halved at £122,081, and after smaller taxation charge, the net profit is £83,346 (*£126,575*). According to the directors, the fall in profits was mainly due to delays in achieving certain planned programmes, particularly for newly developed products, and to increased costs which could not be recovered by advances in price until after the end of the year. The order book is now nearly 40% higher than a year ago, and output for the current year has already shown considerable improvement.

R. B. Pullin and Co. Ltd.

An extension of the premises along the Great West Road is now in the course of erection. This will enable a number of offices to be moved out of the main works, so providing additional space for production. Mr R. B. Pullin, the chairman, also reports that intensified completion is resulting in the breaking down of price structure in many markets, both home and overseas. And despite increases in wages and other costs, he is confident of presenting another satisfactory report for the current year. It is proposed to change the company's name to the Pullin Group Ltd, which will then become a holding company.

Year to 30 Sept.	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earned	Paid	High	Low
1956	195,420	73,558	67	20	7/9	5/8
1957	288,525	85,903	37	20	8/3	5/1
1958	357,775	128,081	57	20	8/3	5/10
1959	397,879	156,890	40	30	14/3	7/10
1960	451,705	189,419	48	25	14/3	10/-

Venner Ltd.

It is proposed to grant options to the full-time working directors to subscribe for Ordinary shares, subject to certain conditions, on the basis of 15,000 for Mr E. Tauchert (chairman and managing director) and 7,500 each for Mr W. H. Marsden, Mr H. F. Heckman and Mr W. A. Devon. There is to be a one-for three rights issue, as we reported on 2 February, and the directors anticipate being able to recommend a dividend for the current year at a rate of not less than 14% on the increased capital. Price of the new issue has yet to be announced.

OVERSEAS NEWS

from our correspondents abroad

CANADA

230 kV Link to Western Ontario

A 65½-mile 230 kV double-circuit line has recently been completed, linking Mount Hope to Buchanan power station. Costing nearly $4 million, the line will increase electrical power supplies to Western Ontario by about 25%. Altogether 243 towers were erected, each tower being 145 ft high.

Tight Money Affects Development

Speaking recently, Mr Cass-Beggs, general manager of the Saskatchewan Power Corporation, said utilities were facing severe limitations as a result of the policy of tight money making it difficult for them to proceed with essential projects. As a solution he suggested that the Federal Government should make available long-term loans at average interest rates without seeking control or profit. Turning to nuclear energy he thought that it would replace hydro power, possibly within 20 or 30 years, in Canada. However, this did not mean that development of the Columbia, Peace, Saskatchewan and other hydro schemes was not still economically necessary today.

Power Exports to US

Surplus power exported to the United States by the Ontario Hydro-Electric Power Commission was sold last year for $3 million. Of this amount $1 million was paid to the Federal Government in Excise Tax.

High Coal Costs in NB

Present high prices of coal are preventing its competition with oil in New Brunswick, said the general manager of the NB Power Co., Mr R. E. Tweeddale, recently. Exclusive use of oil at the company's 17 MW Saint John plant could save $1,000 per day when operating at 80% capacity. Coal was up to 35% more expensive per unit heat output than oil, he said. It was estimated that the Courtney Bay thermal plant would save $500,000 annually by using oil. Mr Tweeddale was presented with the award "The Electrical Man of the Year" recently for his work in helping to establish the Nova Scotia-New Brunswick grid.

Grand Rapids Tenders Opened

Tenders for the Grand Rapids project opened recently revealed bids varying from $29 million to $35 million. These tenders are for the construction of the power house and related structures including excavations. The tenders were submitted by three groups and the successful tenderer will be announced when consulting engineers have examined the tenders in detail.

GRENADA

Power Station Site Chosen

A new power station will be built in Grenada by Grenada Electricity Services this year. Recently a site for the new station was selected.

ECUADOR

Hydro Plant Development

Plans for a hydro-electric power station at Uzcurrumi were recently discussed by the Ecuador Minister of Development and US representatives. The plant, in El Oro Province, would comprise three 8 MW generators in its first stage. A loan is being sought from Eximbank.

URUGUAY

Contract Goes to France

Following the annulment of a contract for consulting engineers' services with an Italian-American consortium, the contract was placed with a French concern. The consultants are required to prepare a report on economic aspects of the Salto Grande hydro-electric scheme for presentation to international credit institutions.

PERU

Peruvian Electricity Expansion

A French company, Socimpex, are constructing generating plants and transmission lines in Peru as the first phase of a national electricity plan. The first phase, embracing 21 MW of generating plant, involves 16 small hydro-electric stations, three thermal stations and 243 km of transmission lines. The work is to be financed by a French loan. Later stages in the plan involve a further 45 MW of plant.

German Hydro Survey

A West German technical mission is studying possible hydro-electric schemes for the Mantaro River. One of the schemes they are considering entails pumping water from the river to a nearby coastal watershed from where it will pass via the Canete River to the Pacific Ocean. In its passage along the Canete River the water will provide power for several hydro-electric stations with a total estimated capacity of 2,000 MW. This scheme will also provide irrigation for large areas of desert.

COSTA RICA

Loan for System Development

A 25-year loan valued at $8·8 million has been approved by the World Bank. The loan will be used to expand electrical generating and transmission facilities in Costa Rica. The loan will be used by I.C.E., an autonomous Government corporation which owns and operates 52% of the country's generating capacity. Although Costa Rica is the second smallest of the South American countries, estimates indicate that the demand for electrical energy is increasing rapidly and may be expected to reach 11% per annum in the next ten years. The loan will finance a 30 MW hydro-plant on the Rio Macho, the first of three such developments with ultimate capacities of 90 MW. Diesel plant at Colima is to be augmented by 8 MW to meet increasing demand in the central zone, which includes the capital San Jose, until the Rio Macho plant is operative in 1963. A 1 MW diesel installation is also scheduled for Limon. Improved transmission facilities will include 48 miles of new lines and substations.

PAKISTAN

Warsak May Expand

The possibility of an increased output from the Warsak hydro-electric power station is likely to be investigated by a Government-appointed committee. The existing station has four hydraulic turbine generators with a total capacity of 160 MW and provision was made during construction for a further two 40 MW units. Whether further capacity will be possible will depend on how it would affect water flow in irrigation canals associated with the scheme.

Village Electrification Plans

Plans for the electrification of 127 villages in Multan and Montgomery were disclosed recently by a WAPDA representative. This year WAPDA proposes spending Rs82 lakhs on electrification programmes in these two districts. Priority will be given to electrification for tubewells. Already 150 have been connected and about 800 more are to be installed on private account.

US Financial Aid

Following the recent announcement that Canada would assist Pakistan with further financial aid under the Colombo plan, the United States is also to make a grant this year of Rs300,000,000. This

grant will be used to finance further construction work on the Karnafuli dam project at Kaptai. Two 40 MW generators are being installed at the dam and provision is made for a third unit. The dam will supply power to Chittagong, Dacca and other areas in East Pakistan. Canadian aid, provided under the Colombo plan, will assist in financing transmission lines from the project to the main Dacca-Chittagong power line.

INDIA

New Cable Plant

Plans for a factory to manufacture p.i.l.c. cables amounting to 650 miles per year are reported to have been completed by the Birla group. We understand the factory, under the name Universal Cables Ltd., will be established at Satna in Central India and that the total outlay may be Rs2 crores. BICC are on the point of reaching agreement for the provision of technical collaboration with Universal Cables. Loans to finance foreign exchange components amounting to Rs80 lakhs have been arranged.

Expensive Nuclear Power Necessary

India would have to establish nuclear power stations even at costs higher than elsewhere said Dr H. J. Bhabha, chairman of the Atomic Energy Commission at a recent symposium. Representatives of the US Atomic Energy Commission said that 14 nuclear reactors were functioning in the US and 21 were under construction. Sir Roger Makins said that by 1966 Britain would have 4.000 MW of nuclear plant and it was anticipated that the Dungeness station, scheduled for completion in 1964, would be 30% cheaper than the Bradwell station due for commissioning this year.

INDONESIA

Bandung Supplied by Hydro Power

Last month saw the inauguration by President Sukarno of one phase of the Tjikalong hydro-electric station. The generators in service will supply the Bandung area with 19·2 MW. Speaking at the inauguration the President said this was a start on Indonesia's hydro development plans which included 335 major projects, estimated to cost a total of Rs240,000 million.

AUSTRALIA

Coal Dispute Settled

The coal dispute over work at the Collie district mines has now been settled, according to information received from the Western Australian State Electricity Commission. The dispute concerned open-cast coal mining and was reported in ELECTRICAL TIMES for 8 Dec., 1960 and 2 Feb., 1961.

330 kV Breakers for Sydney

An order for five 330 kV air-blast circuit-breakers has been placed with AEI by the New South Wales Electricity Commission. The breakers are for a 330 kW substation forming part of the city grid supply fed from the Snowy Mountain scheme and distant thermal stations. The breakers, with short-circuit ratings of 10,000 MVA, will be suitable for both single- and three-phase auto-reclosure.

1960 Sales Increase in Victoria

Electricity sales increased by 8·4% to 4,902 million units during the year ended 30 June, 1960, according to the annual report. The balance between domestic and industrial sales of 30% and 26% has maintained the trend of previous years. Income from sales rose by 9·9% to £46·6 million and the Commission's total sales were £50·5 million, an increase of 11·1% on the preceding year. For the first time the Commission had to finance substantial redemptions of maturing loans in addition to large construction expenditure. The installed plant capacity rose to 1,342 MW with a further 93 MW provided by the Snowy Mountains scheme. During the year the fourth 30 MW generator was commissioned at Morwell and a 96 MW hydro plant at McKay Creek was scheduled for completion by the end of the year. Under construction were the 240 MW extension to Yallourn and orders were placed for the first two 200 MW for the 1,200 MW Hazelwood station. The load factor of the Yallourn power station, the largest in the state, was 81·2%, considerably higher than in the previous 30 years, although the load factor for the total interconnected system had fallen from the 1957 peak figure of 57% to 52·6%. During the year under review, the Commission brought into service 69 miles of 330 kV line, 33·7 miles of 220 kV line and nearly 1,300 miles of 12·7 kV line. One factor of interest to the domestic consumer was the removal in October of restrictions on storage hot-water systems.

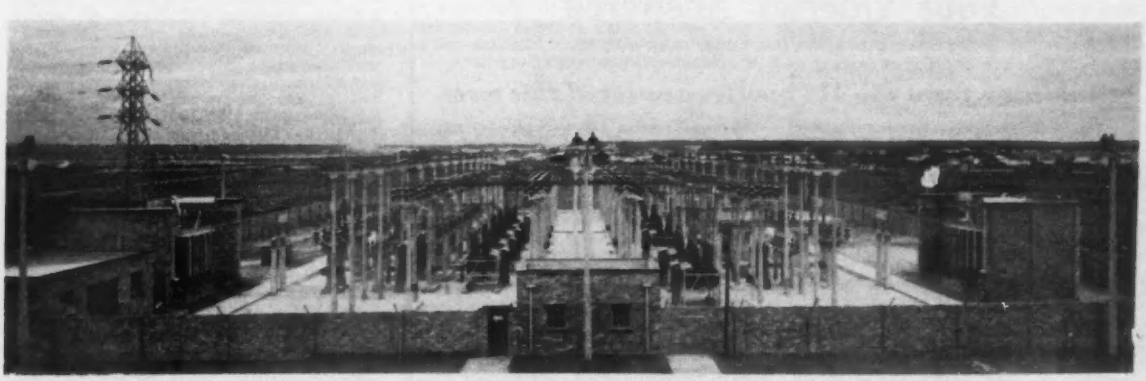
Sharp Fall in WA Profits

Profits disclosed in the 1960 annual report for the Western Australian State Electricity Commission were 28% down on 1959 figures at £65,008. Although sales in the metropolitan area provided the Commission's overall profit, operations of the South West power scheme and other country undertakings resulted in a loss of £160,000. The total revenue for the year was about £8,581,736. The third unit rated 30 MW at the Bunbury station came on load during the year and the final unit is scheduled for completion shortly. Plans are in preparation for a new 120 MW station near Collie and the problem of providing sufficient cooling water for this station has now been solved. Work undertaken on the metropolitan system included the provision of a further 113 miles of 66 kV line and substations totalling 314 MVA. Total electricity sent out during the year was approximately 741,000,000 units, an increase of 7·9% on the previous year. During the year Parliament accepted an amendment allowing consumers to contribute towards mains extensions.

NEW ZEALAND

Hydro Plant May Beat Schedule

Generation at the hydro-electric station at Ohakuri on the Waikato River may begin two months ahead of schedule. All depends on whether the level of lake Ohakuri continues to fill at its present rate. The first two of the four turbines comprising the station's 112 MW capacity will be tested as soon as water level is sufficiently high above intake gates. The station is connected to the North Island supply grid.



This 66 kV substation, nearing completion at Swartkops, will transform the 132 MW output of the Port Elizabeth, South Africa, power station. The 2,500 MVA substation has two 22·5 MVA inter-bus transformers linking 22 kV and 66 kV duplicate busbars. The o.c.b's, voltage transformers and control panels were made by Cooke and Ferguson, and erection was by A. T. Williams (Pty), agents for Crompton Parkinson

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

17 Feb.—Belfast. (a) Electrical installation in additional classrooms, etc., at Royal Academy.—See 9 Feb. issue.

17 Feb.—Croydon C.B.C. Power socket installations in 720 houses, Mitcham Rd estate. —Advertised 2 Feb. issue.

17 Feb.—Edinburgh C.C. Lighting installations in ten houses McLeod St. Applications to City Architect, City Chambers, by above date.

17 Feb.—Elgin. Separate trades, tender 10: electrical work in Divisional Police H.Q. for Scottish N.E. Counties Police Board. County Architect, County Bldgs, Elgin. Applications by above date.

17 Feb.—Northern Hospitals (Scotland). (c) Electrical work in maternity hospital conversion and new kitchen, theatre and staff block, at Broadford Hospital, Isle of Skye. Application to Secretary, Reay Hse, 17 Old Edinburgh Rd, Inverness, by above date.

18 Feb.—Coleraine and Portrush. Maintenance of: buildings and plant—electrical; radio installations and TV sets; and lifts.—See 2 Feb. issue.

18 Feb.—Harlow U.D.C. Erection and wiring of 58 Group "A" concrete columns together with fitting lamps/lanterns on various roads. —See 9 Feb. issue.

18 Feb.—Margate B.C. Supply: Lamps, fittings and cables.—See 9 Feb, issue.

18 Feb.—Saltburn and Marske U.D.C. Electrical installations, 20 flats, Marine Parade. —See 9 Feb. issue.

20 Feb.—Bury C.B.C. Electrical installation, Seedfield County Secondary Modern School. —See 9 Feb. issue.

20 Feb.—Devizes B.C. Provision of bathrooms, electrical installations, etc., 1 to 12 Deramore Row.—See 9 Feb. issue.

20 Feb.—Grimsby C.B.C. (c) Electrical installation, Grange Infants' School.—See 2 Feb. issue.

20 Feb.—Litherland U.D.C. Annual list: Lamps.—See 9 Feb. issue.

20 Feb.—North Antrim Hospitals. Electrical maintenance.—See 9 Feb. issue.

20 Feb.—S. Belfast Hospitals. Supply of (List 8) electrical materials and (List 21) maintenance of refrigerators for year. Group Supplies Officer, Management Committee, Belfast City Hospital, Lisburn Rd. (Tender for List 21 returnable 27 Feb.)

21 Feb.—Ilminster U.D.C. 64 140 W sodium lamps along A303.—See 9 Feb. issue.

21 Feb.—Tyrone C.C. (iii) Electrical installation in new technical institute at Dungannon.—See 12 Jan. issue.

22 Feb.—Durham C.C. Electrical installation renewal at Crook R.C. (Aided) and Trudhoe R.C. (Aided) schools. Applications to County Architect, South St, Durham, by above date.

22 Feb.—North Down Hospitals. Supply: Lamps.—See 9 Feb. issue.

22 Feb.—Redcar B.C. Supply of lamps for year. Borough Engineer, Municipal Bldgs.

22 Feb.—Stirling B.C. Electrical work in erection of 31 houses, St. John St/Academy Rd development.—See 2 Feb. issue.

22 Feb.—West Hartlepool C.B.C. Electrical system installation, High School for Girls. —See 9 Feb. issue.

23 Feb.—Down C.C. Electrical installation in Braniel Primary School extensions. Director of Education, 7 Brunswick St, Belfast 2.

23 Feb.—Ealing B.C. Electrical installation renewal at Drayton Infants' and Perivale Primary schools.—Advertised 26 Jan. issue.

23 Feb.—Inverness B.C. Electrical installations in eight blocks of four-storey flats on four sites. Burgh Architect, 11 High St.

23 Feb.—Isle of Axholme R.D.C. Sewage ejectors and sludge pump complete with motors, starter and accessories for West Butterwick scheme.—See 26 Jan. issue.

23 Feb.—Southampton C.B.C. Electrical installation renewal in Taunton's School. Applications to Borough Architect, Civic Centre, by above date.—Advertised in this issue.

24 Feb.—Edinburgh. Electrical maintenance for year at Gogarburn Mental Deficiency Institution. Secretary and Treasurer, Corstorphine, Edinburgh.

25 Feb.—Argyll C.C. 56 15 ft steel or concrete columns with Class "B" lamps/lanterns/gear at Dunbeg Village.—See 2 Feb. issue.

25 Feb.—Coseley U.D.C. Supply: Electrical materials.—See 9 Feb. issue.

27 Feb.—Flintshire C.C. Supply and erection of one distribution pillar; eight 30 ft columns and 200 W sodium lighting; four advance sign fluorescent units and wiring columns and 12 "keep left" bollards to pillar at A550 Penymynydd Roundabout. County Surveyor, E. W. W. Richards, Llwynegrin, Mold.—Advertised in this issue.

27 Feb.—Golborne U.D.C. Supply: Class "B" concrete and c.i. columns, lanterns, sodium lamps and gear for 188 lighting units.—See 26 Jan. issue.

27 Feb.—Pocklington R.D.C. Booster pumps for Market Weighton.—See 9 Feb. issue.

27 Feb.—W. Fife Hospitals. (2a) Electrical maintenance for year. Secretary and Treasurer, Board of Management, 16 Comely Pk, Dunfermline.

28 Feb.—Dewsbury B.C. Supply: Concrete columns, 140 and 200 W sodium, 250 and 400 W m.v. lanterns, tungsten, sodium and m.v. lamps, swan-neck brackets and spigots, control gear, time-switches.—Advertised 9 Feb. issue.

28 Feb.—Hornchurch U.D.C. Erection of 372 Class "A" columns and 697 Class "B" columns plus the adaption of 71 columns *in situ* for modernisation scheme. Engineer and Surveyor, Council Offices, Billet La. Deposit £2 2s.

28 Feb.—Ossett B.C. Sewage pumping plant. —See 9 Feb. issue.

1 March—Carshalton U.D.C. Supply and erection of 26 15 ft columns for tungsten and two 25 ft columns for 400 W mercury lighting. Engineer and Surveyor, Stone Court, The Grove.

1 March—Manchester C.C. Electrical installations: (contract 357) 20 maisonnettes Wythenshawe; (284A) 12 maisonnettes Ancoats; (344) 28 houses Ancoats; (242F) 14 houses Langley; (337) nine bungalows Chorlton-cum-Hardy. Director of Housing, Town Hall.—Advertised in this issue.

2 March—Belfast C.C. Goods lift installation in Education Dept.—See 2 Feb. issue.

3 March.—Belfast C.C. 33/6·6 kV step-down transformers.—Advertised 2 Feb. issue.

2 March—Pontardawe R.D.C. (a) Supply and erection on fixed price basis of 27 steel columns, lanterns lamps and equipment along various roads. (b) Supply of 178 lanterns, lamps, brackets and equipment. Engineer and Surveyor, Council Offices. Deposit £5.

2 March—Reigate B.C. Supply and erection of 80 Gp "A" steel columns and ancillary equipment. Borough Surveyor, Town Hall.—Advertised in this issue.

3 March.—Braintree and Bocking U.D.C. Electrical installation, in The Institute.—Advertised 9 Feb. issue.

3 March—Cardiff C.C. Electrical services reorganisation, on fixed price basis, in original bldg, Welsh College of Advanced Technology, Cathays Pk. Details from consulting engineers, W. S. Atkins and Partners, 6 Park Pl, Cardiff. Deposit £2 2s made payable to Corpn.

3 March—Flintshire C.C. Supply of: vegetable and dual purpose boilers; cooking ranges; steaming ovens; hot cupboards; sterilising sinks; potato peelers; refrigerators and mixing machines for School Meals Service, Director of Education, County Education Offices, Mold.

3 March—Kirkcudbright C.C. Electrical work in Gatehouse Secondary School alterations and additions. Applications to County Architect: A. Hunter, County Offices, Kirkcudbright, by above date.

3 March—Midlothian C.C. Supply of (List 7) lamps for year. County Clerk, County Bldgs, George IV Bridge, Edinburgh.

3 March.—Southport C.B.C. Electrical installation in Floral Hall.—See 9 Feb. issue.

4 March.—Barrhead B.C. Rewiring of 292 pre-war houses.—See 9 Feb. issue.

6 March—Caterham and Warlingham U.D.C. Supply of (1) 171 140 W sodium lanterns/lamps/gear and (2) 171 25 ft steel columns/brackets. Engineer and Surveyor, Council Offices.

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 112 queries answered this week

"Rosamon" immersion heaters—makers of? S.E.B.—Heating Equipment Ltd., Hughenden Manor, Petersfinger, Salisbury, Wilts.

"Dampp-Chaser" piano heaters—makers of? W.C.—Dampp-Chaser Ltd., Langston Rd, Loughton, Essex.

"Valentine" deep fryers—suppliers of? M.A.N.W.E.B. — Valentine Equipment Ltd., 231 Green St, E.7.

"Torky" electric drills—makers of? M.I.E.—Wolf Electric Tools Ltd., Pioneer Wks, Hanger La, Ealing, W.5.

"Atomix" mixers—makers of? C.S.E.—Measuring and Scientific Equipment Ltd., 14 Spenser St, S.W.1.

Sterling-Croydon Clocks Ltd.—address for? E.E.W. — Boden Wks, Chard, Somerset.

"Kallicaps" lampshade attachments—address for? L.E.—Exchange Productions, 41 Cheetham Hill Rd, Manchester 4.

Harvey Hubbell Ltd.—address for? T.E.—P.O. Box 10, Knoll Rd, Camberley, Surrey.

"Mixmaid" mixers — suppliers of? L.E.B.—Valmade Ltd., Browells La, Feltham, Middx.

"Allites" circular television lamps with design illuminated from behind—makers of? F.P.—Allites Ltd., 45 Tavistock Cres., W.11.

6 March—Magherafelt. Electrical installation in proposed new voluntary secondary intermediate school. Details from Varming and Mulcahy, 37 Malone Rd, Belfast. Deposit £5 5s.

6 March—Stourbridge B.C. Electrical work in 492 pre-war houses divided into four groups of between 69 and 221, on various estates. Borough Engineer and Surveyor: H. W. Morris, Council Hse. Deposit £2 2s.

6 March.—W. Riding C.C. Rewiring Shipley Grag Rd Junior School.—See 9 Feb. issue.

8 March.—Bridge-Blean R.D.C. 60 g.p.m. at 64 ft head duplicate sewage pumps, etc., for Chislet scheme.—See 2 Feb. issue.

8 March—Kilmarnock B.C. (1) Supply of lamps for year. Burgh Surveyor's Office, 11 London Rd.

9 March—Northwich R.D.C. Supply and erection of 42 Group "A" concrete columns and 52 140 W sodium lamps/lanterns/gear. Engineer and Surveyor, Whitehall, Hartford, Northwich. Deposit £2 2s.

9 March—Sunderland C.B.C. Electrical installation in Monkwearmouth Comprehensive School. Borough Architect, Grange Hse, Stockton Rd.—Advertised in this issue.

10 March—Sunderland C.B.C. Electrical installations in 277 dwellings, Town End Farm estate. Borough Architect, Grange Hse, Stockton Rd.—Advertised in this issue.

11 March—Caithness C.C. Electrical work in 123 houses on 14 sites in 1961 programme. County Architect, County Offices, Wick.

13 March—Stockport B.C. Electrical installation in new ambulance depot, Heaton La. Borough Architect, Town Hall.

17 March—Grimsby C.B.C. (c) Electrical installation in six-form entry instalment of comprehensive school at Ely Rd. Borough Engineer and Architect: J. V. Oldfield, Municipal Offices, Town Hall Sq. Deposit £5.

17 March—Wilton B.C. Street lighting installation, Seagrim estate and Burcombe La. Borough Surveyor, Municipal Offices, Wilton, Wilts.

20 March.—Nottingham C.C. Centrifugal well pumps, motors, switchgear, etc., for Basford.—See 2 Feb. issue

21 March.—Bedfordshire C.C. (b) Electrical installation in Clapham/Oakley County Secondary School.—See 19 Jan. issue.

No date stated.—Boston Group Hospitals. Applications invited for electrical maintenance work.—See 9 Feb. issue.

No date stated.—Herts C.C. Applications invited for inclusion in list for electrical work.—See 2 Feb. issue.

CONTRACTS PLACED

Belfast C.C. Electrical installation, Fane St Secondary School, Rotary Electric Co. (Belfast) Ltd.

British Railways (Scottish Region). Train describer equipment for Perth resignalling scheme, Westinghouse Brake and Signal Co. Ltd.

Doncaster R.D.C. Supply and installation of 97 140 W sodium lamps on 25 ft concrete columns, Concrete Utilities Ltd., £3,789. Recommended.

Edmonton B.C. Electrical installation, Block B, Snells Pk redevelopment, Holmes and Larkinson, £4,678.

Manchester C.C. Airport terminal area road and car park lighting, General Electric Co. Ltd.

St. Albans R.D.C. Supply and erection of 26 140 W sodium lamps on steel columns, North Orbital Rd, A405, Abacus Municipal Ltd.

Sheffield C.C. Electrical installations at Broomgrove and Woodville hostels, T. W. Sampson and Co. Ltd.

Wessex Hospital Board. Electrical work: Gleave Villa and wards M3 and 4, St. James Hospital, Portsmouth, G. E. Taylor and Co. (London) Ltd., £2,464, and Shields and Marshall, £3,097, respectively: Southampton Moorgreen Hospital, C block, Groves and Co., £2,364. Recommended.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

24 Feb.—America. Current, potential and distribution transformers, horn gap and disconnecting switches and fusegear. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center. B.o.T. (ESB/4264/61).*

26 Feb.—Egypt. Motors for General Petroleum Authority, 44 Rue El Messaka, Dokki, Cairo. B.o.T. (ESB/3879/61).*

28 Feb.—America. Two 161 kV, 1,200 A c.b.'s. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center. B.o.T. (ESB/3079/61).*

1 March—Belgium. 115,000 kgm 1·4 m.m. diameter copper wire, Regie des Telegraphes et des Telephones, Direction de la Transmission et du Material, rue des Palais, 42 Bruxelles 3. B.o.T. (ESB/4253/61).*

14 March—Ceylon. Diesel generating sets, transmission and distribution system for Minneriya. Chairman, Tender Board, Ministry of Agriculture, P.O. Box 500, Colombo. B.o.T. (ESB/3085/61).*

16 March—Australia. One 19 MVA and three 15 MVA three-phase 33,000/10,850 V transformers. General Manager, Sydney C.C., Box 4009, G.P.O. B.o.T. (ESB/3821/61).*

17 March.—New Zealand. 33 kV current limiting reactors. Town Clerk's Office, P.O. Box 5045, Dunedin. B.o.T. (ESB/700/61).*

23 March—India. Lifting hoists and swivelling jib. D.C. of Stores, Locomotive Component Wks, 4 Chittaranjan Ave, Calcutta 13. B.o.T. (ESB/3030/61).*

25 March—Sudan. 10,000 yd 100 pair underground telephone cable. Controller, Stores and Workshops, Dept. of Posts and Telegraphs, Light Industrial Area, Khartoum South. B.o.T. (ESB/4294/61).*

27 March—Australia. Dust extraction plant for Vales Point, E.C. of N.S.W., Box 5257, G.P.O., Sydney. B.o.T. (ESB/3071/61).*

30 March—Australia. 34 items including: ammeters, voltmeters, watt meters, current transformers, light meters and recording meters. Controller, Stores and Contracts, Postmaster-General's Dept., 114 Russell St, Melbourne C.1. B.o.T. (ESB/3850/61).*

30 March—Pakistan. Two 500 kW dual fuel generating sets for East Wharves, Keamari, Karachi. B.o.T. (ESB/4263/61).*

31 March—Burma. 65 items including accessories, fluorescent fittings, irons, washing machines, refrigerators, mixers, toasters, vacuum cleaners, cookers, motor starters, hair clippers, coffee grinders, iron-clad switches, etc. Commercial Manager, Rangoon Electric Supply, 502 Merchant St, Rangoon. B.o.T. (ESB/34003/60).*

29 June—Australia. Two cooling towers for Muja Station. Secretary, W.A. Government Tender Board, 74 Murray St, Perth. B.o.T. (ESB/510/61).*

No date stated—Salvador. Applications for details of 15 MW Guajoyo H.E. Project to go to Harza Eng. Co., 400 West Madison St, Chicago 6, Ill. B.o.T. (ESB/2555/61).*

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

C in design. 799,746. Class 9. Power transmission systems, switchgear, converters, transformers, circuit breakers, relays, resistances, capacitors, electromagnetic cores and electric cables, etc. 799,748. Class 12. Electric motors and electric locomotives, etc. 799,749. Class 17. Electrical insulating material, etc. Allmänna Svenska Elektriska Aktiebolaget, Västeras, Sweden.

Dialamatic. 801,325. Class 7. Clothes washing machines. Bendix Home Appliances Ltd., Albion Wks, Kingsbury Rd, Birmingham 24.

Emi in design. 809,578. Class 7. Drying, washing and ironing machines. Electrical and Musical Industries Ltd., Blyth Rd, Hayes, Middx.

Executive. 807,481. Class 9. Lighters. Dorset Light Industries Ltd., 88 East St, Bridport.

Glidemaster. 810,327. Class 8. Shavers. Sunbeam Corpn., 5,600, Roosevelt Rd, Chicago, Illinois, U.S.A.

Gyra-flo in design. B803,648. Class 7. Fans, etc. Midland Heating and Ventilation Co. Ltd., Bedford Rd, Birmingham.

Industrion. B806,993. Class 11. Gas cleaning apparatus. W. C. Holmes and Co. Ltd., Whitestone Iron Wks, Turnbridge, Huddersfield.

Lorra Lite Ltd. in design. 810,108. Class 11. Lamp shades. Lorra Lite Ltd., 18B London Rd, S.E.23.

Magnetstat. 809,094. Class 9. Current control magnetic apparatus, etc. Associated Electrical Industries Ltd., 33 Grosvenor Pl, S.W.1.

Medco. 806,657. Class 9. Electronic signalling apparatus for mine cars, etc. Mining Electronic Developments Co., 9 Church St, Stretton, Burton-on-Trent.

Monoptic. B808,142. Burglar and fire alarms, etc. Burgot Alarms Ltd., 26 Westbourne Grove, W.2.

Panelume. 805,606. Class 9. Appliances being parts of wiring installations for controlling lighting, etc. Thorn Electrical Industries Ltd., 105-109 Judd St, W.C.1.

Philips in design. 796,503. Class 9. Scientific and electrical apparatus, etc. 789,566. Class 10. Electrically-heated blankets, X-ray image intensifiers, etc. Philips Electrical Ltd., Century Hse, Shaftesbury Ave, W.C.2.

Poly-Opal. B804,641. Class 11. Lampshades, etc. Duncan, Partners and Price Ltd., 33 Petergate, S.W.11.

Pyrobond. 808,475. Class 11. Lampholders and ceiling roses. Ashley Accessories Ltd., Morecambe Rd, Ulverston, Lancs.

Robophone. 809,724. Class 9. Message recorders for use with telephones, etc. Automation Telephones (London) Ltd., 32 Orkney St, S.W.11.

Sparkonite. 807,905. Class 9. Electrodes for spark machining. Mallory Metallurgical Products Ltd., 78 Hatton Gdn, E.C.1.

TRADE NOTES

Changes of Address. The Technical Sales Division of Smart and Brown (Eng.) Ltd. has moved to Menin Wks, Bond Rd, Mitcham, Surrey. Telephone: Mitcham 0154.

As from 31 March next, all sales and manufacturing activities of Astral Switchgear Ltd. will be transferred to a new factory at Morecambe Rd, Ulverston, Lancs. Telephone: Ulverston 3333.

The Leeds office of A. Reyrolle and Co. Ltd. has been transferred from the city centre to new premises at Elton Lodge, Newton Rd, Leeds 7. The chairman, Mr H. H. Mullens, and Mr J. Bennett, general manager and director, recently paid an official visit to the offices.

The Midlands area sales office of Enfield-Standard Power Cables Ltd. has moved to Fazeley St, Birmingham 5. Telephone: Victoria 5885.

New Telephone Nos. The telephone no. of the Extrusion Division of High Duty Alloys Ltd. has been changed to Workington 2581.

The telephone no. of the Birmingham office of Pyrotenax Ltd. is now Midland 2924.

Change of Name. The title of Craxford Mouldings Ltd. has been changed to Viking Industrial Plastics Ltd.

New Branch. Wolf Electric Tools Ltd. have opened a service branch at 94-96 Heaton Rd, Newcastle upon Tyne. Telephone: Newcastle 659053.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Bell Road Reconditioned Washing Machines Ltd., 32 Bell Rd, Hounslow, Middx. To take over the business carried on at Hounslow, Middx, by John R. Hewson and Edward Pryer, etc. Nom. cap.: £100. Dirs.: John R. Hewson and Edward Pryer.

Bradley and Son (Electrical) Ltd., 24 Sandbed La, Belper, Derbys. Nom. cap.: £5,000. Dirs.: Ronald Bradley and Audrey Bradley.

Britlec (Electrical) Ltd., 206a Poulton Rd, Wallasey. Nom. cap.: £1,000. Dirs.: John J. Jones and Dorothy Jones.

Cannon Electric International Inc. British address: 168-172 Old St, E.C.1. Capital: 10,000 shares of Common Stock of $1. Name of person authorised to accept service: Edwin A. Cavanagh, 168-172 Old St, E.C.1.

Chrysler Airtemp Ltd. Manufacturers of and dealers in air-conditioning, de-humidifying, heating, temperature control and other machinery, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: J. W. Jeffrey and P. D. Maloney, 18 Austin Friars, E.C.2.

Crane and Hoist Supplies Ltd., 36-40 Spring St, Sheffield. To take over business of crane manufacturers, electrical and mechanical engineers carried on by Street Crane Co. Ltd., at Sheffield, etc. Nom. cap.: £3,000. Dirs.: not named. Subs.: Peter R. Street and W. J. Salter.

John A. Frank and Co. Ltd. To take over the business of an electrician carried on at 35 Queen St, Manchester 2, by J. A. Frank, etc. Nom. cap.: £100. Dirs.: John A. Frank and Mrs Marjorie S. Frank, 79 Grosvenor Rd, Urmston, Manchester.

Victor Mara Ltd. To design, manufacture, construct, erect and deal in scenery, mechanical and electrical equipment and appliances and furniture, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: James C. G. Crichton, 48 Radipole Rd, S.W.6; and D. F. Reynoldson, 23 Vines Ave, Finchley, N.3.

M.E.C. (Refrigeration) Ltd., 82-4 New King's Rd, Fulham, S.W.6. Manufacturers of and dealers in refrigerators, etc. Nom. cap.: £100. Permanent dirs.: Maurice E. Corfe and Mary I. Corfe.

J. H. Oberman and Sons (Electrical Contractors) Ltd., 11 New Walk, Leicester. To acquire that branch of the business of electrical contracting maintenance, subcontracting and all work of an electrical nature carried on by J. H. Oberman and Sons Ltd., etc. Nom. cap.: £10,000. Permanent dirs.: John E. Oberman and Thomas C. Oberman.

J. H. Oberman and Sons (Retail) Ltd. To acquire that branch of the business of retailing of all electrical goods, cycles, toys, games and fancy goods carried on by J. H. Oberman and Sons Ltd., etc. Other details similar to J. H. Oberman and Sons (Electrical Contractors) Ltd.

Parrish Instruments Ltd., 37-9 High Holborn, W.C.1. Electronic and automation engineers, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Joseph R. Parrish and Ninette A. Cable.

F. S. Powell Ltd., 274 Higham Hill Rd, E.17. Radio, television and electrical engineers, etc. Nom. cap.: £100. Dirs.: Frederick S. Powell and Mrs Jean K. Powell.

Randall and Daniels (Electrical) Ltd., 30 Christopher Rd, Skewen, Glam. Electrical engineers, etc. Nom. cap.: £3,000. Dirs.: David T. A. Randall and Edward Daniels.

Refrigeration Services (York) Ltd., 1 Lord Mayors Walk, York. Manufacturers of and dealers in electrical equipment, etc. Nom. cap.: £500. Dirs.: Frank McGarry, Cyril G. Croft and Charles d'Ardley.

Refrigeration Spares (Manchester) Ltd. Nom. cap.: £4,000. Dirs.: to be appointed by the subs. Subs.: Marion Simmons and Gwendoline G. Ellston, 59-67 Gresham St, E.C.2.

P. Robbins Ltd., 69 Gloucester Pl, W.1. Manufacturers of and dealers in electrical goods, etc. Nom. cap.: £100. Dirs.: Philip Robbins, Mrs June N. Robbins and Mrs Anne Davis.

Ryan Electrics Ltd., 134 Acre La, S.W.2. Manufacturers of and dealers in washing machines, etc. Nom. cap.: £5,000. Dirs.: Arthur L. Ryan and Patricia E. Ryan.

H. B. Talbot Ltd., 23 Filey St, Sheffield 10. Manufacturers of and dealers in electrical goods, etc. Nom. cap.: £1,000. Dirs.: Harry B. Talbot and Mrs Violet A. Talbot.

G. H. Taylor and Co. (Nethersfield) Ltd., 32 Meadow Rd, Netherfield, Nottingham. Manufacturers of and dealers in heating elements, etc. Nom. cap.: £5,000. Dirs.: George H. Taylor and Agnes Taylor.

G. F. Thorne (Stafford) Ltd., 58 Gaol Rd, Stafford. To carry on business of electrical contractors, etc. Nom. cap.: £5,000. Dirs.: Geo. F. Thorne and Mrs Vera M. Thorne.

J. R. Welbourn Ltd., 11 High Skellgate, Ripon. Manufacturers of and dealers in domestic, household and general electrical and other equipment, etc. Nom. cap.: £3,000. Dirs.: Joseph R. Welbourn and Mrs Amelia M. Welbourn.

Wentonette Ltd. To carry on the business of electrical engineers, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Laurence R. Battell, 117 Hart Rd, Thundersley, Essex; and William J. Wildman.

W.S.D. Services Ltd., 174 Herbert Ave, Parkstone, Poole. Electricians, etc. Nom. cap.: £100. Dirs.: Kenneth Sivyer, Bernard Woosey, Mrs Irene Sivyer and Mrs Roma Woosey

GAZETTE ANNOUNCEMENTS

BANKRUPTCY ACTS

Receiving Orders

Barrow-in-Furness. L. Probert, radio and electrical goods dealer, of 32 Monks Brow, Barrow-in-Furness. Receiving order dated 8 Feb.

Liverpool. Cresta Electric Lamp and Eng. Co., electrical engineers, of 108 The Northern Rd, Crosby, Liverpool. Receiving order dated 26 Jan.

First Meeting and Public Examinations

High Court of Justice. V. C. Jones, electrical goods dealer, carrying on business as Victa-Vision Radio and Television, of 40 Hornsey Rd, N.7. First meeting: 11 a.m., 21 Feb.; and public examination: 11 a.m., 29 March, both at Bankruptcy Bldgs, Carey St, W.C.2.

Leicester. K. Perkins, radio, electrical and television retailer, carrying on business as K.P. County Electrics at 60-62 rear Leicester Rd, Oadby. Public examination: 10.30 a.m., 21 April, at The Castle, Leicester.

Blackpool. L. Jacques, electrical retailer, carrying on business at 134 Moston La, Moston. Public examination: 10.30 a.m., 19 April, at Court Hse, S. King St, Blackpool.

Nottingham. D. Peters, electrician, formerly carrying on business at 2 Manor Rd, Carlton. Public examination: 10 a.m., 6 April, at Court Hse, St. Peter's Gate, Nottingham.

Leicester. I. Challoner, radio and electrical retailer, carrying on business, in partnership, as Midland Radiovision Services, at Main St, Humberstone. Public examination: 10.30 a.m., 21 April, at The Castle, Leicester.

Bristol. D. C. McCallum, domestic appliance proprietor, formerly carrying on business as Bristol Utilities at Fox Rd, Eastville, and 294 North St, Bedminster. Public examination: 10.30 a.m., 24 March, at Old Council Hse, Corn St, Bristol 1.

Release of Trustee

Hastings. W. J. Broomfield, trading as the Bone Electric Fencing System, Churchfield Cottage, Gt. Glemham, Saxmundham. Trustee: T. H. Parker, 8 Old Steine, Brighton 1, released as from 27 Jan.

Appointment of Trustees

Coventry. D. Roberts and F. J. Webb, domestic appliance retailers, carrying on business as Rowe Electrical Services at 130 Foleshill Rd and Corporation St, Coventry. Mr K. D. Wickenden, Stoneleigh Chmbrs, 2 Queen's Rd, Coventry, appointed trustee as from 17 Jan.

Bridgwater. L. A. James, radio and electrical engineer, carrying on business as Domestic Electrics at 42 Clare St. Mr P. W. Hort, 28 Baldwin St, Bristol 1, appointed trustee as from 10 Jan.

Macclesfield. C. T. Powell, electrical engineer, carrying on business as George Cooke and Co., at Station Rd, Wilmslow. Mr S. K. Stott, 2 Booth St, Manchester 2, appointed trustee as from 11 Jan.

COMPANIES ACTS

Glenhose Ltd. Creditors to send details to liquidator: J. S. Meyler, 2 Marlborough Pl, Brighton 1, by 28 Feb.

G.B.H. Distributors (Stoke-on-Trent) Ltd. Creditors to send details to liquidator: P. J. Snow, 17 Albion St, Hanley, by 3 March.

Domesticaids (Western) Ltd. Mr R. P. Booth, 5 Rumford Pl, Liverpool 3, appointed liquidator at extraordinary general meeting on 1 Feb. for the purpose of voluntarily winding-up.

Jon Electrics Ltd. Meeting of creditors to be held at Bank Chmbrs, 1 John St, Bedford Row, W.C.1, on 22 Feb. at 3 p.m. Secured creditors to lodge details at registered office by 4 p.m., 21 Feb.

Geoff Allen (Mansfield) Ltd. Mr H. J. Robinson, 30 John St, Mansfield, appointed liquidator at extraordinary general meeting on 19 Jan. for the purpose of voluntarily winding-up.

B. Pearson Products (Electrical) Ltd. First meetings of creditors and contributories to be held at Official Receiver's Office, Pearl Chmbrs, East Parade, Leeds 1, on 21 Feb., at 11 and 11.30 a.m., respectively.

Deamer Sales Ltd. First meetings of creditors and contributories to be held at Official Receiver's Office, 20 Byrom St, Manchester 3, on 22 Feb., at 11 and 11.30 a.m., respectively.

D. G. Stewart Ltd. First meetings of creditors and contributories to be held at Room 401, Inveresk Hse, 346 Strand, W.C.2, on 22 Feb., at 2.30 and 3 p.m., respectively.

Alan Breck Ltd. Meeting of creditors to be held at Law Institute, Albion Pl, Leeds, on 22 Feb., at 2.30 p.m.

Companies Winding-up

J. and D. Clayton (Edgware) Ltd., 9-13 Bridge St, Hemel Hempstead, Herts, dealers in domestic appliances and electrical goods.

The Official Receiver reported to the recent meeting of creditors that preferential debts amounted to £362, and others to £12,764 (£9,548 trade accounts). Assets were estimated to realise £517.

The company was formed in Oct., 1959, with an issued capital of £1,000. Mr Clayton, a former director, had said that in 1959 he was a director of a group of companies dealing in a wide range of goods from High St, Edgware, which expanded into domestic appliances, etc., and the company was formed for that purpose.

The company ceased trading in July, 1960, and assets, mainly stock, were sold for about £600 to an associated company, after which a debenture holder appointed a receiver. The petition for winding-up followed.

Creditors left the case with the Official Receiver as liquidator.

BUSINESS PROSPECTS

Abingdon B.C. Tender: 44 dwellings at Gainsborough Green redevelopment site. Architect, A. Roscoe-Hudson, The Market Pl, Faringdon, Berks.

Aldershot. Henning and Chitty, 30 Percy St, W.1, architects for £¼ million rebuilding Lille Barracks.

Ayr. Hourstons, Alloway St, plan £95,000 extensions at 30-32 Alloway St.

Barnet. Ravenseft Properties, 52 Charles St, W.1, plan shopping centre on site of former Gaumont Cinema, High St.

Basildon. £200,000 premises for H.M. Stationery Office to plans by M. of W. Architects' Dept, Abell Hse, John Islip St, S.W.1.

Bath T.C. Tender: Five blocks of five/six storeys, each containing 12 maisonnettes and six flats. Planning Officer.

Batley B.C. Tender: One block 20 maisonnettes, one block 18 maisonnettes, two blocks 12 flats and one block six flats. Engineer.

Bently U.D.C. Library with electric floor heating planned, Amersall Rd, at cost of £18,000. Surveyor.

Berkshire. Youth Centres at Abingdon, Didcot, Newbury and Wokingham to cost £35,000 each, and neighbourhood centres at Bracknell and Maidenhead, £15,000 each.

Birmingham. Hospital Board, Edgbaston, plans conversion of old nurses' quarters at All Saints Hospital into accommodation for patients. Cost £14,000.—Two new halls of residence (High Hall and Ridge Hall) planned by University at Edgbaston. Architects, H. G. Wicks, of Harvey and Wicks, 119 Hagley Rd, Edgbaston, Birmingham.—Corporation recommended to approve two junior special training centres at Selly Oak and Stechford to cost £72,532.

Bolton. Manchester Hospital Board, Cheetwood Rd, Manchester, plan ungrading the Musgrave Ward at Royal Infirmary.

Bristol. Stubbs and Burt, 17 St. Stephen's St, Bristol 1, plan Bridge St, Kingswood factory.

Bromley. Grenfell Baines and Hargreaves, 4 Cavendish Pl, W.1, architects for M. Howard's Hayesford Park Estates shopping centre, with maisonnettes.

Brownhills U.D.C. Tender: 20 Commonside dwellings. Engineer, Charles H. Hunt, Coombe Hse, Brownhills.

Bury St. Edmunds. Grenfell Baines and Hargreaves, 12 Guildhall St, Preston, architects for Methodist Home for the Aged.

Castle Donington R.D.C. Tender: 34 pairs houses, Windmill Fields estate. Architects, McCarthy Collings and Co., 187 Forest Rd, Coalville.

Chelmsford. A. E. Wiseman, 10 Duke St, Chelmsford, architect for warehouse and offices, Navigation Rd, for E. J. Rippon and Son.—F. J. Taylor, Son and Bracken, 78 New London Rd, Chelmsford, architects for headquarters, etc., at Westway for Marconi International Marine Communications Co.

Cheltenham. Chamberlin, Powell and Son, 1 Lamont Rd Passage, Lamont Rd, S.W.10, architects for rebuilding of Cheltenham Grammar School.

Colchester. C.C. approves plans for £100,000 works of improvements at Royal Grammar School.

Croydon. Raybruns Ltd., 380 London Rd, Croydon, plan shops, showrooms, offices and car-park, London Rd.—Southern Shop Development Co., plan supermarket with offices over, at 73-77 London Rd.

Dagenham. Abbey Kapok Mnfg Co., Selinas La, Dagenham, plan factory and offices.

Darlington. Industrial Marine Salvage Ltd., Station Rd, Hatton, Co. Durham, plan industrial buildings at Union Pl.—Cairns and Byles, 8 Osborne Rd, Newcastle, electrical consultants for E.C.'s Branksome School.

Dover. W.O. plans partial demolition and reconstruction of Connaught Barracks, Castle Hill at £575,000.—Also planned is stage two of modernisation and extensions at Old Park Barracks at £¼ million.

Dublin. Desmond Rea O'Kelly, 15 Fitzwilliam Sq, Dublin, structural consulting engineer for Irish Transport and General Workers Union's £300,000 17-storey headquarters at Eden Quay and Beresford Pl.

Edgware, Middx. Newman, Levinson and Ptnrs, 9 Mansfield St, W.1, architects for Regents Park Land Co's offices at High St, Edgware.

Elstree. F. W. MacKenzie and Ptnrs, 235 Regent St, W.1, architects for £¼ million distribution depot at Shenley Rd, Boreham Wood.

Enfield B.C. Tender: Nine flats, seven maisonnettes, seven shops, etc., Baker St. Engineer and Surveyor, Deryck Peake, Little Park Gdns, Enfield.

Folkestone. Chamberlin, Powell and Son, 1 Lamont Rd Passage, Lamont Rd, S.W.10, architects for redevelopment of land from War Memorial to Langhorne Gdns.

Gateshead. Shopping centre and housing accommodation at Wrekenton planned. Engineer.

Gillingham B.C. Tender: 12 dwellings in Brompton Group F redevelopment area. Engineer's Department.

Gravesend B.C. Tender: 95 houses and 48 flats, Singlewell estate. Engineer.—Turner and Kitching, 137 Windmill St, architects for Britannia Lead Co's canteen at Northfleet.

Greenock. Corporation has £2 million redevelopment plan for St. Lawrence St/Belville St area. Nine blocks of multi-storey flats (including two 21-storey blocks) with total of 714 dwellings are planned.

Grimsby R.D.C. Improved street lighting in several villages at £9,765. Surveyor.

Guildford. Weyside Engineering Wks (1926), plan new premises at site of old isolation hospital.

Hastings B.C. Tender: 73 dwellings on Groomgrove estate site. Engineer.

Hayes. Theo. Birks, 38 Portland Pl, W.1, architect for office block at junction of Uxbridge Rd and Springfield Rd.

Hove. Morgan and Carn, 12 Grand Ave, architects for £700,000 hotel and flats for Villapost.

Hull. William Pearson plan factory for refining organic chemicals at Clough Rd.

Huntingdon. A. N. Gear and Assoc., 12 Manchester Sq, W.1, architects for Victaulic Co's £¼ million factory.

Kent. Scannell and Manby, 48b London Rd, Kingston, Surrey, quantity surveyors for gynaecological block at Pembury Hospital.

Leeds. Industrial and Investment Services Ltd., 129 Finsbury Pavement, E.C.2, plan redevelopment of Empire site in Briggate.—H. J. Emery Ltd., Basford, Newcastle, contractor for Birmingham Hospital Board's £58,186 annexes (phase 2) at St. Edward's Hospital, Cheddleton.—Town Tailors Ltd., Bespoke, Mabgate, Leeds 9, plan factory on 2½-acre site at Seacroft light industrial estate.

Littlehampton. E. W. Owen, Norfolk Hse, Beach Rd, Littlehampton, architect for E. R. Ranger's Gloucester Rd factory.

Liverpool. Serron Investments Ltd., plan showrooms, offices and warehouse, Devon St.

London. Du Bosky and Ptnrs, 28 Berkeley Sq, W.1, are quantity surveyors for factory and offices at Roberts Pl, E.C.1.—S.E. Metropolitan Hospital Board, Eastbourne Terr, W.2, plan £27,654 stage 1 of development at St. Alfege's Hospital, Greenwich, S.E.10.—Sydney Clough, Son and Ptnrs, 39 Devonshire St, W.1, architects for amenity block and dental school for London Hospital and Medical College, Stepney Way and New Rd, E.1.—Governors of Colfes Grammar School plan £256,734 scheme for teaching and administrative blocks, assembly hall and gymnasium for 600 boys at Woolwich, S.E.18.—White and Traviss, 19 Ludgate Hill, E.C.4, architects for Transport and General Workers Union's new district offices and meeting place at Salter St, E.14.—E. S. Boyer and Ptnrs, 88 Gray's Inn Rd, W.C.1, architects for shops and offices in Pentonville Rd, N.1, for Wintex Finance and Discount Co.—R. Seifert and Ptnrs, 34 Red Lion Sq, W.C.1, architects for commercial premises at Lodge Rd, St. John's Wood.—J. S. Gibson, Gordon and Montague, 22 Welbeck Way, W.1, architects for rebuilding premises at Oxford St, W.1, of Marshall and Snelgrove.—Mortgage and General Investment Corporation plan fire station, embassy offices and flats at Chesham Pl, S.W.1.—J. Brewster, 16 Porchester Pl, W.2, architect for £260,000 seven-storey hotel at Conduit Pl, W.2, for Stephen Court Ltd.

Londonderry. Birmingham Sound Reproducers Ltd., Lone Moor Wks, Londonderry, plan £¼ million college for apprentices.

Longendale U.D.C. Tender: 26 dwellings, Taylor St site, Hollingworth. Surveyor.

Luton. Park Investments, Park La, W.1, plan shops and offices, Dunstable Rd.—Howell and Brooks, 4 Queen Victoria St, E.C.4, architects for shops and offices at New Bedford St.

Macclesfield B.C. Tender: 60 dwellings in scheme 10e. Architect.

Manchester T.C. Tender: Aged persons homes at Falskirk Rd, Wythenshawe and Goodier St, Harpurhey. Architect.—Airport Committee recommends approval for hotel on land near airport.

Market Harborough U.D.C. Conversion of gas lamps to electricity at £7,000.

Middlesex. W.O. plans R.A.O.C. surveyor production centre at Feltham. Cost £200,000.

Morpeth R.D.C. 500 Ellington site houses planned. Surveyor.

Newcastle. Tasker and Ptnrs, 25 New Bridge St, Newcastle, architects for Austin Lifts' Penn St factory additions.

North Riding C.C. South Bank office block near Middlesbrough planned. Architect.

Northumberland C.C. Child welfare centres planned at Longbenton, Whitley Bay, Monkseaton, Shiremoor and Dudley. Architect.

Nuneaton. A. Conner and Co., Fife St, plan factory extensions, Queens Rd.—Essex, Goodman and Suggitt, 20 Waterloo St, Birmingham 2, architects for £110,000 extensions to King Edward VI School.

Peterborough. Third and fourth instalments of Technical College to cost £187,596. Architect to Education Board.—T.C. plan 124 dwellings, Dogsthorpe IV estate.

Peterhead. Allan and Friskin, 16 Castle St, Dundee, architects for Radiation's proposed factory.

Pontefract B.C. Tender: 34 bungalows, Mill Hill. Surveyor.

Portardawe R.D.C. Tender: 26 dwellings at Plas Rd, Rhos. Engineer.

Reading. Sainsbury and Chamberlain, 14 Cross St, Reading, on behalf of owners of land at London Rd and Eldon Rd, plan block of offices on site of Robert Gort and Son.

Shrewsbury. R. J. Husband, 126 Wigmore St, W.1, architects for multi-storey car-park at Barker St, planned by Phillip Allman and Co.—Shropshire County Education Committee approves scheme for erection of hostel at Shropshire Farm Institute, Walford Heath, at cost of £78,300.

Spennymoor. Durham Divisional Coal Board (No. 4 area), plan headquarters and offices. Plans by N.C.B. Divisional Architects Dept, Team Valley Estate, Gateshead.

Stoke-on-Trent. Birmingham Hospital Board plans boiler house, boiler plant, etc. at City General Hospital, £120,000, and cardiological department, £7,900.

Surbiton B.C. Tender: 12 old persons' dwellings at 14 South Pl. Clerk.

Sutton. Robert J. Wood and Ptnrs, 29 Widmore Rd, Bromley, Kent, architects for 12-storey office block with shops and car-parks, planned at Brighton Rd.—Five-storey

Business Prospects (continued)

shops and office block planned on Cock Hotel site for Commercial and Suburban Properties, 15 New Bond St, W.1.

Swansea. C. G. Vaughan and Ridgewell, 1 St. James' Gdns, architects for £50,000 shopping arcade for Traders' Reconstruction (Swansea).—B.P. plan £70,000 administrative centre at Queens Dock oil terminal.

Uxbridge. Rewiring scheme for some 1,500 pre-war council houses is planned by housing committee. Lighting circuits rewired and power circuits installed—two power points in kitchens, two in sitting rooms and one in each bedroom. Cooker circuits with control panels and immersion heater circuits will also be provided.

Watford. Davis, Belfield and Everest, 9 Ashley Pl, S.W.1, quantity surveyors for Clements' (Watford) £270,000 extensions.

West Wickham. Newman, Levinson and Ptnrs, 9 Mansfield St, W.1, architects for shops and offices at Station Rd for Regents Park Land Co., who have similar plans for High St, Weston-super-Mare, Somerset.

Whiston R.D.C. Tender: 20 bungalows, Milton Ave. Engineer and Surveyor.

Worthing. Fewster and Gamble, 5 Liverpool Gdns, Worthing, architects for Willenhall Hotes' 11-storey block of 64 flats at Bath Rd.

MEETINGS TO NOTE

THURSDAY, 16 FEB.

I.E.E. Faraday Lecture: "Transistors and All That," L. J. Davies. Central Hall, S.W.1. 6 p.m.

I.E.E. (Southern). "Silicon Controlled Rectifiers," D. D. Jones. South Dorset Technical College, Weymouth. 6.30 p.m.

I.E.E. (Irish). "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," J. S. Forrest, P. J. Lambeth and D. F. Oakeshott. Physical Laboratory, Trinity College, Dublin. 6 p.m.

I.E.E. (N.E. Graduates and Students). "Automatic Position Control of a Machine Tool," N. S. Blyth. Sunderland Technical College. 6.30 p.m.

PLASTICS INSTITUTE. Swinburne Award Address: Prof G. Gee. Royal Institution. 6.30 p.m.

DIESEL ENGINEERS AND USERS' ASSOCIATION. "Diesel Propulsion Machinery for Small Ships," J. B. Griffith. Institute of Marine Engineers, 76 Mark La, London E.C.3. 2.30 p.m.

S. WALES INSTITUTE OF ENGINEERS. "The Single Conductor Multi-channel Signalling and Telemetering System," F. C. Riches. Institute Bldgs, Park Pl, Cardiff. 6 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (E. Midlands). "Instrumentation at the British Sugar Corporation," R. M. J. Withers. University, Leicester. 7.15 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Scotland). A.G.M. and "Some Industrial Applications of Magnetic Power," T. G. Hawker. Institute of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow C.2. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Southern). "Materials Handling," H. P. Mott. Polygon Hotel, Southampton. 7.15 p.m.

FRIDAY, 17 FEB.

I.E.E. (Electronics and Communications Section). "A Comprehensive Introduction to Plasma Physics," W. B. Thompson. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (E. Midlands). Dinner-dance. Victoria Station Hotel, Nottingham. 7.30 p.m.

I.E.E. (N. Staffs). Annual dinner. Crown Hotel, Stone. 7.30 p.m.

I.E.E. (Cardiff Graduates and Students). "Parametric Amplification," V. David. S. Wales Institute of Engineers, Park Place. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS. "Bio-engineering," H. S. Wolff. Pepys Hse, 14 Rochester Row, S.W.1. 7 p.m.

A.S.E.E. (Stoke and Crewe). "Light as an Aid to Industrial Production," T. Catten. Grand Hotel, Hanley. 7.30 p.m.

ELECTRICAL TRADES COMMERCIAL TRAVELLERS' ASSOCIATION. Annual lunch. Connaught Rooms, W.C.2. 12.45 p.m.

MONDAY, 20 FEB.

I.E.E. (Mersey and N. Wales). Third Hunter Memorial Lecture: "The Application of Electronics to the Electricity Supply Industry," J. S. Forrest. (Joint meeting with the N. Western Centre.) Town Hall, Chester. 6.30 p.m.

I.E.E. (N.E. Measurement and Electronics Group). Discussion: "The Experimental Solution of Field and Flow Problems." Rutherford College of Technology, Northumberland Rd, Newcastle upon Tyne. 6.15 p.m.

I.E.E. (N. Western). Third Hunter Memorial Lecture: "The Application of Electronics to the Electricity Supply Industry," J. S. Forrest. (Joint meeting with the Mersey and North Wales Centre.) Chester Town Hall. 6.30 p.m.

I.E.E. (Sheffield). "Operating Experience at Calder Hall," K. L. Stretch. Angel Hotel, Brigg. 6.30 p.m.

I.E.E. (Western Supply Group). "Short-Circuit Ratings for Mains Cables," G. S. Buckingham; "A Basis for Short-Circuit Ratings for Paper-Insulated Cables up to 11 kV," L. Gosland and R. G. Parr. S. Wales Institute of Engineers, Park Pl, Cardiff. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS (Nuclear Energy Group). Discussion: "The Influence of Availability of Enrichment on Reactor Type and Design." Birdcage Walk, S.W.1. 6 p.m.

BIRMINGHAM ELECTRIC CLUB. "Trends in Distribution Transformer Design and Manufacture," R. Watson. Grand Hotel. 6.15 p.m.

A.S.E.E. (Bristol and West). "Earthing," P. W. Cave. The Grand Hotel. 8 p.m.

IPSWICH AND DISTRICT ELECTRICAL ASSOCIATION. "Russian Industrial Electrification," E. H. Norgrove. Electric Hse. 7.15 p.m.

I.E.S. (Leeds). Presidential address. British Lighting Council, 24 Aire St. 6.15 p.m.

TUESDAY, 21 FEB.

I.E.E. (Measurement, Supply and Utilisation Sections). "Sphere-Gaps," E. Kuffel. Supported by three further papers. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N. Midlands Utilisation Group). "The Application of Power Transistors to the Operation of Gas-Discharge Lamps from d.c. Supplies," I. F. Davies and D. Dunthorne. Leeds and County Conservative Club, South Parade, Leeds 1. 6.30 p.m.

I.E.E. (N.W. Measurement and Control Group). "Precision Measurement," G. H. Rayner and A. Felton: "Improvements in the Precision Measurement of Capacitance," G. H. Rayner and L. H. Ford: "The Design of an Audio-Frequency Amplifier for High-Precision Voltage Measurement," S. Harkness and F. J. Wilkins; "The Design and Performance of High-Precision Audio-Frequency Current Transformers," J. J. Hill and A. P. Miller; "Techniques for the Calibration of Standard Current Transformers up to 20 kc/s," J. J. Hill. Engineers' Club, Albert Sq, Manchester. 6.15 p.m.

I.E.E. (S.E. Scotland). "British Nuclear Power Today," A. L. Shaw. Carlton Hotel, Edinburgh. 7 p.m.

I.E.E. (S. Midlands Graduates and Students). "Power from the Atom by Fission and Fusion," K. W. Huddart. Venue to be arranged.

I.E.S. (Liverpool). "Lighting of Niagara Falls," D. J. Reed and T. D. Proctor. Industrial Development Centre of M.A.N.W.E.B., Paradise St. 6 p.m.

I.E.E. (Rugby Graduates and Students). "Colour Television," P. S. Carnt. College of Engineering Technology. 6.30 p.m.

INSTITUTION OF CIVIL ENGINEERS. James Forrest Lecture: "Elastic Theory and Engineering Structures," Prof A. J. S. Pippard. Gt. George St, S.W.1. 5.30 p.m.

A.S.E.E. "Operation of Electrical Plant in Hazardous Areas," W. J. F. Cocks. I.E.E. Lecture Theatre, Savoy Pl. 6.30 p.m.

A.S.E.E. (Oxford and Districts). "About the Supergrid," H. B. Dreyfus. Employment Exchange. 8 p.m.

WEDNESDAY, 22 FEB.

I.E.E. (Electronics and Communications Section). "Coding Theory and Its Applications," J. M. Meggitt. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (E. Midlands). "Telecommunications—Modern Developments," N. Fox and D. D. Wright. George Hotel, Kettering. 7.30 p.m.

I.E.E. (Southern). "Aircraft Electrical Power Systems," H. Zeffert and J. P. Ratcliffe. (Joint meeting with the Royal Aeronautical Society.) The University, Southampton. 7 p.m.

I.E.E. (S.W. Scotland). "Radiocommunication in the Power Industry," E. H. Cox and R. E. Martin. Institution of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS. "Controlled Fusion Reactions," Prof P. M. S. Blackett. Birdcage Walk, S.W.1. 6 p.m.

INSTITUTE OF ELECTRICITY ADMINISTRATION. "Office and Workshop Security," H. R. Niven. The Bonnington Hotel, Southampton Row, W.C.2. 6.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (S. Wales). "The Manufacture, Properties and General Uses of Metal Bellows," R. W. Houghton. Newport and Monmouthshire College of Technology, Newport. 6.45 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Tees-side). "New Steel-making Processes and Their Control Problems," Dr P. A. Young. Cleveland Scientific and Technical Institute, Corporation Rd, Middlesbrough. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Shrewsbury). "Production Planning and Control by Computer." New Technical College, London Rd. 7.30 p.m.

I.E.E. (S. Midland Graduates and Students). "Power from the Atom by Fission and Fusion," K. W. Huddart. College of Technology, Wolverhampton. 7 p.m.

I.E.E. (Sheffield Graduates and Students). "The Introduction of Planned Maintenance into Mines," M. Wilson. College of Technology, Chesterfield.

THURSDAY, 23 FEB.

I.E.E. Annual dinner. Grosvenor Hse, Park La, W.1. 7.30 p.m.

I.E.E. (E. Midlands). "Design of a Defensive Guided Missile," J. A. Robinson. (Joint meeting with the Institution of Mechanical Engineers.) Lecture Theatre, Portland Bldg, Nottingham University. 6.30 p.m.

I.E.E. (Western Utilisation Group). "The Development of the Magnetic Particle Clutch Including Reference to its Industrial and Automotive Applications," E. G. Barratt. S. Wales Electricty Board Demonstration Theatre, Kingsway, Swansea. 6 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Chester). "The Atomic Clock," J. V. L. Parry. Lecture Theatre, Admin. Bldg, The Associated Ethyl Co. Ltd., Oil Sites Rd, Ellesmere Port, Wirral. 7 p.m.

I.E.S. (Leicester). "Basis of Recommended Illumination Levels in Britain and the U.S.A.", A. W. Marsden. Demonstration Theatre, E.M.E.B., Charles St. 6.15 p.m.

A.S.E.E. (S. London). "Transistors." Greyhound Hotel, High St, Croydon. 8 p.m.

A.S.E.E. (N. Ireland). "The Transistor—Principles of Operation, Manufacture and Applications," F. Szekely. Central Hall, Rosemary St, Belfast.

FRIDAY, 24 FEB.

I.E.E. (N.E. Graduates and Students). "Some Aspects of the Control and Guidance of Guided Weapons," J. A. Miller. Grey Hall, King's College, Newcastle upon Tyne. 6.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Scottish). "Interesting the Instrument Mechanic in Fundamental Principles," F. Rout. Building Centre, Sauchiehall St, Glasgow. 7.15 p.m.

A.S.E.E. (Newcastle upon Tyne and District). Annual dinner. County Hotel.

A.S.E.E. (S.W. London). Annual dinner. Prince of Wales Hotel, S.W.19.

MONDAY, 27 FEB.

I.E.E. (S. Midlands Electronics and Measurement Group). "Electronics in Medicine," P. R. Styles. James Watt Memorial Institute, Birmingham. 6 p.m.

I.E.E. (N. Eastern). "A General Theory of Depreciation of Engineering Plant," D. Rudd. Neville Hall, Newcastle upon Tyne. 6.30 p.m.

I.E.E. (Western Utilisation Group). "The Organisation of Industrial Electrical Maintenance," S. R. Phelps. S.W.E.B. Demonstration Theatre, The Centre, Bristol. 6 p.m.

I.E.E. (Hatfield). "Magnetic Properties of Thin Films for Computing Devices," E. M. Bradley. Hatfield Technical College. 7 p.m.

I.E.S. (Birmingham). A.G.M. and "Plastics for Lighting." W. E. Harper; "Glass for Lighting," J. G. Holmes. Regent Hse, St. Phillips Pl, Colmore Row. 6 p.m.

INSTITUTION OF PLANT ENGINEERS (W. and E. Yorks). "Fuel Economy and Productivity," K. Higginson. Houldsworth School of Applied Science, Leeds University. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (N. Midlands). "Numerical Analogue Control of Machine Tools," O. S. Puckle. Louis Room, St. James's Restaurant, Derby. 7 p.m.

ELECTRICAL ASSOCIATION FOR WOMEN. Caroline Haslet Trust Lecture: "Women Engineers in the U.S.S.R.," Miss L. S. Souter and Miss R. Winslade. Institution of Electrical Engineers, Savoy Pl. 6 p.m.

TUESDAY, 28 FEB.

I.E.E. (S. Midlands). Faraday Lecture: "Transistors and All That," L. J. Davies. Town Hall, Birmingham. 7 p.m.

I.E.E. (N.W. Supply Group). "The Protection of High-Voltage Insulators From Power Arc Damage," A. E. Guile. Engineers' Club, Manchester. 6.15 p.m.

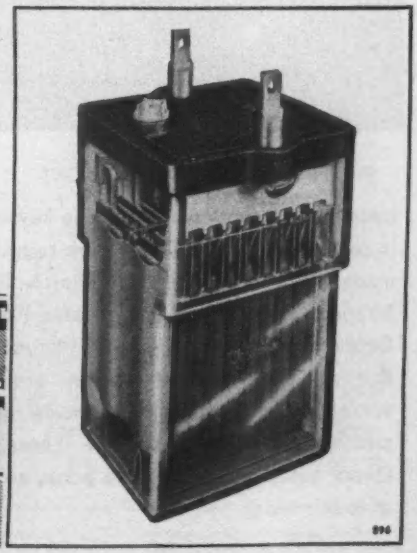
INSTITUTION OF PLANT ENGINEERS (S. Wales). "Industrial Lighting," R. S. Hazell. S. Wales Engineers' Institute, Park Pl, Cardiff. 7.30 p.m.

Save stand-by battery space with the new **CHLORIDE** Stationary Cell

THIS LIGHT, robust cell, with its Planté positive and pasted negative plates, Porvic microporous separators and many other improvements in material and design, saves up to 50% of previously necessary battery space—yet performs its duties with greater efficiency and complete reliability. Specially designed for stand-by duties entailing discharge rates between, say, the 3-hour and the very high rates demanded for switch-closing purposes, it is ideal for trickle-charge operation and has all the remarkable length of life associated with the Planté type of construction.

The field in which the new cell is designed to replace current Planté types is a very wide one. Emergency lighting*, switch operation and emergency supply in hospitals, theatres, cinemas and other public buildings, nuclear and conventional power stations, all rely on trickle-charged batteries. In Great Britain today such batteries occupy millions of cubic feet of valuable space. The new Chloride cell could free almost half of it.

*The new cell will from now onwards be fitted in all Keepalite units—the Chloride Company's automatic emergency lighting system.



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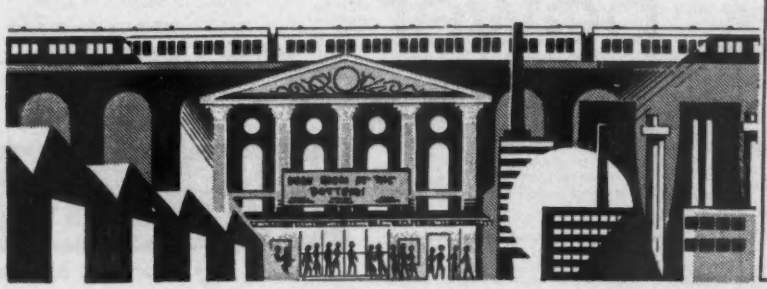
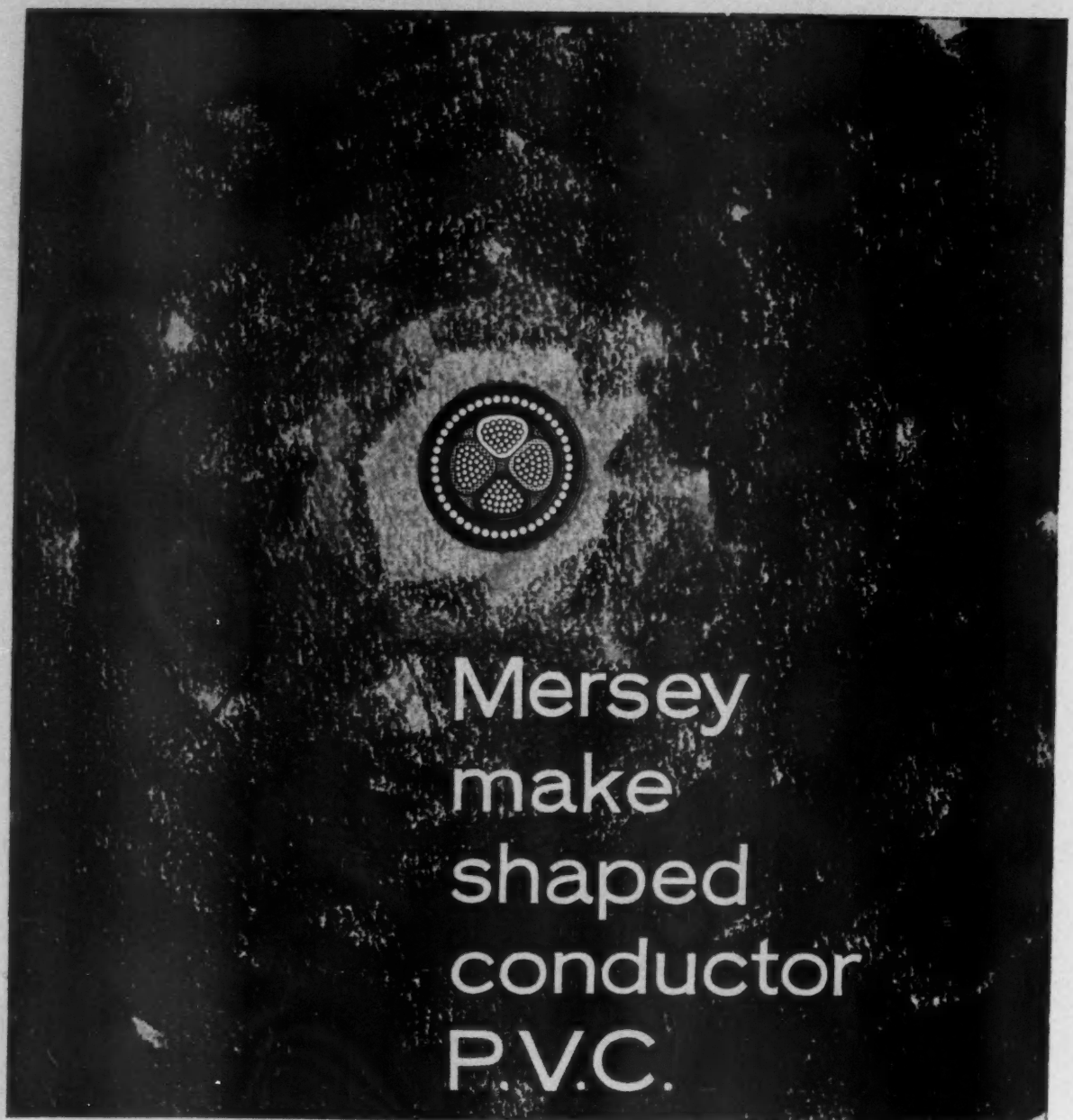
Makers of Exide Batteries



Enquiries to: London Elgar 7991; Bristol 664086; West Bromwich 2361; Leeds 20248; Glasgow, Bridgeton 3734; Manchester Blackfriars 1158; Belfast 27953



MG.2

insulated power cables

Used in all situations where the keyword is reliability, Mersey Cables are ruggedly made for underground power distribution. Shaped Conductor PVC Insulated Power Cables can be installed and forgotten. But don't forget that Mersey are the versatile cable people, with a wide range and a reputation for service. There's a Depot listed in your 'phone book, so get in touch today.

A.S.E.E. ELECTRICAL ENGINEERS EXHIBITION
EARLS COURT
MARCH 21st-25th
VISIT US ON STAND H.13 & H.15

MERSEY CABLES

ELECTRICAL DIVISION

MERSEY CABLE WORKS LIMITED, LIVERPOOL 20 *Telephone:* BOOTLE 4111

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

SOUTHAMPTON C.B.C.

INVITES TENDERS for Renewal of Electrical Installation at Taunton's School. Write for particulars to Borough Architect, Civic Centre, Southampton, by 23 Feb., 1961. Tender returnable by 13 March, 1961. (T 620)

FLINTSHIRE COUNTY COUNCIL

A.550-Lighting of Penymynydd Roundabout

TENDERS are invited for this lighting scheme, comprising provision and erection of one distribution pillar, eight lighting columns with 30 ft mounting height and 200 W sodium cut off lanterns, four fluorescent lighting units for Advance Direction Signs and the wiring of eight lighting columns and 12 "Keep Left" bollards to distribution pillar.

Tender documents can be obtained from E. W. W. Richards, Esq., A.M.I.C.E., A.M.I., STRUCT.E., A.M.I.MUN.E., County Surveyor, Llwynegrin, Mold. Tenders in plain sealed envelope marked "27/2 Lighting at Penymynydd," should reach the undersigned not later than noon on Monday, 27 Feb., 1961.

W. HUGH JONES,
Clerk of the County Council.

County Buildings,
Mold. (T 621)

BOROUGH OF REIGATE

TENDERS are invited for the SUPPLY AND ERECTION OF 80 GROUP "A" STEEL LIGHTING COLUMNS AND ANCILLARY EQUIPMENT.

Apply Borough Surveyor for Documents.

Sealed Tenders in envelopes provided to the undersigned by 2 March, 1961.

The Council does not bind itself to accept the lowest or any Tender.

HEBER DAVIES,
Town Clerk.

Town Hall,
Reigate.
16 Feb., 1961. (T 593)

CITY OF MANCHESTER-HOUSING COMMITTEE

TENDERS invited (returnable 1 March, 1961) for Electrical Installations to the following:

Contract 357: 20 maisonnettes at Wythenshawe.

Contract 284A: 12 maisonnettes at Ancoats.

Contract 344: 28 houses at Ancoats.

Contract 242F: 14 houses at Langley.

Contract 337: Nine bungalows at Chorlton cum Hardy.

Particulars and documents obtainable from Director of Housing, Town Hall, Manchester 2. (T 612)

COUNTY BOROUGH OF SUNDERLAND

TENDERS are invited for ELECTRICAL INSTALLATION TO MONKWEARMOUTH COMPREHENSIVE SCHOOL. Tender documents obtainable from Borough Architect, Grange House, Stockton Rd, Sunderland.

Sealed tenders endorsed "Tender for Electrical Installation—Monkwearmouth Comprehensive School." must be received at my office, Town Hall, not later than 9 March, 1961.

G. S. McINTIRE,
Town Clerk.
(T 623)

COUNTY BOROUGH OF SUNDERLAND

TENDERS are invited for ELECTRICAL INSTALLATION IN 277 DWELLINGS. Tender documents obtainable from Borough Architect, Grange Hse, Stockton Rd, Sunderland.

Sealed tenders, endorsed "Tender for Electrical Installation in 277 Dwellings, Town End Farm Estate," must be received at my Office, Town Hall, not later than 10 March, 1961.

G. S. McINTIRE,
Town Clerk.
(T 622)

LLANELLY RURAL DISTRICT COUNCIL

Sodium Lighting on Trunk Road A48 (Crosshands)

TENDERS are invited by the above Local Authority for the following on a fixed-price basis on trunk road A48, within the Rural District of Llanelly:

(a) Supply and erection of 12 steel columns with 140 W Sodium Discharge Lamps.
(b) Supply and erection of 2 steel columns with 85 W Sodium Discharge Lamps.
(c) Supply and delivery only of 21 140 W Sodium Discharge Lamps complete.

Copies of Specification, Bill of Quantities and plans may be obtained by post from the Architect and Surveyor to the Council, 2 Queen Victoria Rd, Llanelly, on payment of a deposit of £2 2s, made payable to the Llanelly Rural District Council, which will be returned on receipt of a bona fide tender and return of documents loaned.

Tenders marked "Street Lighting A48" in plain sealed envelopes should be lodged with the undersigned not later than 12 o'clock noon on Tuesday, 14 March, 1961. The lowest or any tender will not necessarily be accepted.

C. B. HUGHES,
Clerk of the Council.

Castle Buildings,
Llanelly.
Carms.
14 Feb., 1961. (T 645)

APPOINTMENTS VACANT

THE NORTH EASTERN ELECTRICITY BOARD

Tyne Sub-Area

APPLICATIONS are invited for the appointment of

SECOND ASSISTANT DISTRICT COMMERCIAL ENGINEER
GATESHEAD SERVICE CENTRE

Applicants should be suitably qualified engineers and have experience in the utilisation of electrical energy in commercial and domestic premises, a knowledge of installation work and be conversant with tariffs, sales and all aspects of consumers' service.

Salary Schedule A, Class F, Grade 8, £965/£1,090. N.J.B. Conditions of Service.

Applications stating age, qualifications and experience, to be received by Assistant Secretary (Establishments), The North Eastern Electricity Board, G.P.O. Box No. 117, Carliol Hse, Newcastle upon Tyne 1, within ten days of the appearance of this advertisement. (T 629)

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

GENERAL ASSISTANT ENGINEER (CHEMIST)
CASTLE DONINGTON POWER STATION
Vacancy No. 23/61.

APPLICATIONS are invited for the position of General Assistant Engineer (Chemist) at Castle Donington Power Station, near Derby.

Candidates should possess the Ordinary National Certificate in Chemistry as a minimum qualification, and should have previous experience in the analysis and testing of coal, water and oil, preferably in a power station laboratory.

The salary will be within the range £625/£805 per annum of the National Joint Board Agreement.

Closing date for receipt of applications: 24 Feb., 1961.

This appointment will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT, which may be obtained from the Station Superintendent, and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.
(T 631)

THE SOUTH WALES ELECTRICITY BOARD

COMMERCIAL ASSISTANT

APPLICATIONS are invited for the position of Commercial Assistant in the Swansea District of the Swansea and West Central Area.

The successful applicant will be required to undertake duties mainly in the Development Section of the Commercial Department and preference will be given to Engineers possessing a Higher National Certificate in Electrical Engineering.

Salary: N.J.B. Class G, Grade 9, Scale 7. £965/£1,090 per annum. (It is expected that the classification will shortly be raised to H.)

Applications stating age, present position, present salary, qualifications and experience, should be addressed to G. R. T. Edwards, B.SC., M.I.E.E., M.AM.I.E.E., Manager, Swansea and West Central Area, 29 Ystrad Rd, Swansea Industrial Estate, Swansea, to arrive not later than 4 March, 1961. Please quote reference 16/61/ET, endorsing envelope "Commercial Assistant."

R. G. WILLIAMS,
Secretary.
(T 624)

CENTRAL ELECTRICITY GENERATING BOARD

South Western Division

Vacancy No. ET/AV/24/61.
STATION SHIFT CONTROL ENGINEER

REQUIRED at Portishead "A" Power Station.

Superannuation Scheme. Salary: N.J.B. Class J, Grade 10, Scale 8, £1,040/£1,165, plus 10% Shift Allowance.

Candidates should possess good technical qualifications and should have had training and experience in the Control and Operation of steam generating plant and Main Switchgear in a modern power station.

Applications on form AE6/ACT, obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 28 Feb., 1961. (T 628)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 46s. per inch, and all other classified advertisements at 3s. 6d. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

CENTRAL ELECTRICITY GENERATING BOARD
Eastern Division

APPLICATIONS are invited for appointments as

GENERAL ASSISTANT ENGINEERS

as follows:

LITTLE BARFORD GENERATING STATION
(ST. NEOTS, HUNTS)
(S.V. No. 1440)

PETERBOROUGH GENERATING STATION
(NORTHANTS)
(S.V. No. 1441)

Salaries: N.J.B. within the range £625/£825 per annum, plus £90 per annum shift allowance whilst engaged on shift duties.

The commencing salaries will depend upon the duties and responsibilities.

Housing accommodation may be available for the successful applicant at Little Barford Generating Station.

Duties of the above posts include assisting in the Electrical Control Room and experience in the technical operation of electrical, boiler house and turbine house plant, testing, etc., in a generating station and provide a suitable basis for promotion to higher technical grades.

Manual workers in skilled grades with suitable technical training will be considered. Previous experience in a generating station and/or technical training to the standard of Ordinary National Certificate or its equivalent will be of advantage.

Applications, quoting the appropriate Reference S.V. No., stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts, to arrive not later than 25 Feb., 1961. (T 603)

CITY OF SALISBURY-ELECTRICITY DEPARTMENT
VACANCY FOR
SENIOR ELECTRICAL ENGINEER
(INSTALLATION)

SALARY Scale: £1,768 2s 6d x £51 5s 0d—£1,921 17s 6d. p.a.

Applications are invited for the fixed establishment post of Senior Electrical Engineer (Installation) in the Salisbury Municipal Electricity Department, on the above scale, commencing salary at the minimum of the grade. No cost of living or other allowances are payable.

Candidates must be corporate members of the British Institution of Electrical Engineers and/or hold an equivalent electrical engineering degree.

The post requires experience in the general application of electricity to industrial, commercial and domestic premises, the preparation of estimates for and planning of such installations, general knowledge of Electricity Regulations, and the commissioning and maintenance of electrical plant and installations. The successful candidate will serve in the Consumers' Engineer's Section as assistant to the Installation Engineer.

The appointment will be subject to the City Council's Service and Leave Regulations. The successful candidate will be required to furnish to the Council a satisfactory medical certificate of fitness and to serve a probationary period of not less than six months, and if thereafter confirmed in his appointment, to join the Southern Rhodesia Local Authorities' Joint Pension and Widow's and Orphans' Fund. He must also be able to comply with the requirements of the Federal Immigration Authorities.

Candidates must submit full particulars of their qualifications, training and experience, giving details of positions held and salaries received. Age, place of birth, nationality and marital status should be stated and copies of not more than three recent testimonials may be forwarded.

Particulars of the undertaking, and a summary of conditions of service, pension and leave entitlements, etc., may be obtained from Messrs Merz and McLellan, Carliol Hse, Newcastle upon Tyne 1, to whom applications must be submitted on or before 3 March, 1961. (T 550)

CENTRAL ELECTRICITY GENERATING BOARD
ASSISTANT ENGINEERS

REQUIRED in the STATION PLANNING SECTION of the Planning Department at Headquarters, London S.E.1.

The Section is concerned with the planning of new generating capacity in England and Wales. It is responsible for the investigation and selection of sites for both conventional and nuclear power stations and for the negotiations for statutory and other consents for both types of station.

Candidates should possess an honours degree or the requisite qualifications for corporate membership of the Institutions of Mechanical, Civil or Electrical Engineers. A sound engineering or scientific background is essential and an aptitude for forward thinking is desirable. It would be an advantage to have experience of power station design and layout, economic studies, or one or more of the problems arising in the siting of power stations, e.g., fuel transport and reception; the thermal and hydraulic aspects of the use of large volumes of river or sea water for cooling purposes; ash disposal; questions of town and country planning.

Salaries on scales within the range £1,005/£1,890 p.a., according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary, to the Appointments Officer, 24-30 Holborn, London E.C.1, by 28 Feb. Envelopes should be marked "Confidential Ref. ET/64." (T 583)

THE UNITED LIVERPOOL HOSPITALS AND THE SOUTH LIVERPOOL HOSPITAL MANAGEMENT COMMITTEE

APPLICATIONS are invited for appointment to a new post of

ELECTRONICS TECHNICIAN

The work will be associated primarily with the heart departments of the Royal Liverpool Children's Hospital and the Sefton General Hospital.

The duties will include diagnosis of faults, repair, maintenance and calibration of all types of medical/electronic equipment, electrical and general instruments, controllers and recorders; and also the design and construction of components and the modification of machinery and equipment to meet special medical needs. There is scope for the exercise of initiative in a new field of hospital activity, and opportunity for innovation and research in collaboration with the medical and technical staffs in the heart departments.

Applicants must possess the Higher National Certificate in Electrical Engineering (with Electronics) and have some relevant practical experience or hold a degree in electrical engineering or be a Corporate Member of the Institution of Electrical Engineers.

The salary scale is £800 x £30(5)—£950 a year. The post is superannuable. Whitley Council Terms and Conditions of Service apply.

Apply, stating age, qualifications and experience and giving the names of three persons to whom reference may be made to the Secretary, 80 Rodney St, Liverpool 1, by 22 March, 1961. (T 594)

THE NORTH WESTERN ELECTRICITY BOARD
No. 1 Sub-Area, Manchester
APPOINTMENT OF SUB-AREA MANAGER
(Second Advertisement)

APPLICATIONS are invited by the Board for the post of Sub-Area Manager, No. 1 Sub-Area, Manchester.

Candidates should have experience in management and administration in the Electricity Supply Industry.

Salary: N.J.M. and H.E. Grades Committee. Class E, Grade 10, £3,765 x £75—£3,915 x £105—£4,020 p.a.

Details, including qualifications and experience, should be addressed to the Secretary, The North Western Electricity Board, Cheetwood Rd, Manchester 8, by 27 Feb., 1961.

Applications in response to the previous announcement of this vacancy are being considered. (T 596)

THE NORTH WESTERN ELECTRICITY BOARD
THIRD ASSISTANT ENGINEER
MAINS CONSTRUCTION SECTION
SUB-AREA ENGINEERING DEPARTMENT
MANCHESTER

APPLICANTS should have had extensive experience in the installation and maintenance of cable systems of all types and voltages in congested and industrial areas, and in major substations. They should also be fully conversant with the latest cable and jointing techniques up to 33 kV, and should have been responsible for the supervision of major works by both direct labour and contract.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,275/£1,410 p.a., Grade M.10. N.J.B. Conditions.

FOURTH ASSISTANT ENGINEER
(CHARGE ENGINEER)
OPERATION SECTION
SUB-AREA ENGINEERING DEPARTMENT
MANCHESTER

The duties will include assisting the Senior Charge Engineer in carrying out the operational control of a large E.H.V. transmission and distribution system, involving the use of supervisory control and system switching. The system inter-connects a number of Power Stations. Applicants must be prepared to perform shift duties.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,115/£1,245 p.a., Grade M.12. N.J.B. Conditions.

SECOND ASSISTANT DISTRICT ENGINEER
EAST DISTRICT
CHORLTON-ON-MEDLOCK
MANCHESTER

The duties will include the supervision of the erection and maintenance of substation switchgear, laying and jointing of cables, and switching operations on the H.V. and L.V. systems within the District as required. Applicants should have had a wide general experience on the distribution side of electricity supply and be prepared to undertake standby duties.

Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £1,190/£1,325 p.a., Grade H.7. N.J.B. Conditions.

Applications on forms to be obtained from the Manager (Staff Vacancy), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, and returned to him by 27 Feb., 1961. (T 614)

LONDON ELECTRICITY BOARD
CHIEF ENGINEER

THE London Electricity Board require to appoint a Chief Engineer to the Board to succeed Mr. L. H. Welch, O.B.E., B.SC., M.I.E.E., on his retirement in April, 1961.

Applications are invited from suitably qualified persons who must be corporate members of the Institution of Electrical Engineers and have had wide experience with large electricity supply organisations.

The initial salary will be not less than £4,000 per annum, but will be settled according to the experience and qualifications of the person appointed.

Applications stating age, qualifications, experience, present position and salary should be made by 7 March, 1961, to the Chairman of the Board at 46 New Broad St, London E.C.2. (T 613)

CORPORATION OF GLASGOW
ARCHITECTURAL AND PLANNING
DEPARTMENT
ASSISTANT ELECTRICAL ENGINEERS

APPLICATIONS for the above superannuable appointment are invited from graduates and associate members of the Institution of Electrical Engineers.

Salary scale: £850/£1,385, with placing according to qualifications and experience. There is a point within the scale at which increments may be accelerated.

Form of application may be obtained from the Principal Administrative Officer, 20 Trongate, Glasgow C.1.

A. G. JURY,
City Architect and Director of Planning.
(T 601)

CENTRAL ELECTRICITY GENERATING BOARD
South Eastern Division
DIVISIONAL ELECTRICAL ENGINEER'S DEPARTMENT
Vacancy Nos. 52/61 and 53/61.
FOURTH ASSISTANT ENGINEERS (SERVICES)
CROYDON AND NORTHFLEET DISTRICTS

CANDIDATES must possess Higher National Certificate in Electrical Engineering or equivalent qualification, and be interested in automatic protective gear and control gear associated with major electrical plant in power stations and sub-stations.

Salary: N.J.B. Class AX, Grade 11, £905/£1,140 per annum including London Allowance, with prospects of promotion subject to satisfactory service.

Applications giving age, details of qualifications, experience, etc., should be sent to the Personnel Officer, Central Electricity Hse, Lower Ham Rd, Kingston upon Thames, Surrey, to arrive by 27 Feb.

W. H. DUNKLEY,
Divisional Controller.
(T 626)

SOUTH EASTERN ELECTRICITY BOARD

ENGINEER'S Department at Surrey Sub-Area Headquarters, Dorking.

THIRD ASSISTANT ENGINEER
(PLANNING AND DEVELOPMENT)

Salary: £1,190/£1,325 p.a., on N.J.B. Class L, Grade 10. Superannuable. Duties will be to assist in the preparation of schemes and estimates for extensions of, and reinforcement to, underground and overhead networks up to and including 33 kV.

FOURTH ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE)

Salary: £965/£1,090 p.a., on N.J.B. Class L, Grade 13. Superannuable. Duties will be chiefly concerned with plant maintenance and the testing and commissioning of system protection on networks up to and including 33 kV. A particular knowledge of, or interest in, system protection would be an advantage.

Applicants for the above two appointments should be of at least H.N.C. standard; they should indicate the particular post applied for and should have experience appropriate to that post.

ENGINEERING DRAUGHTSMAN

Salary: £965/£1,090 p.a., under N.J.B. conditions, Class L, Grade 13. Superannuable. Applicants must be good draughtsmen, quick and accurate, with some technical knowledge or works experience. The work will include the layout and detail of indoor and outdoor substations of 33 kV and below, including the preparation of circuit diagrams.

The appointments offer opportunity for work in a rapidly expanding area on the outskirts of London supplying 307,000 consumers and sales amounting to 1,321 million units per annum. Consideration will be given to private car allowance (excluding the planning and development and draughtsman posts) and to assistance for house purchase in appropriate circumstances.

Applications for the above three appointments, quoting ET and naming two referees on forms from Surrey Engineer, Seeboard, Rough Rew, Ridgeway Rd, Dorking, Surrey, by 1 March, 1961.

ASSISTANT DISTRICT ENGINEER
KINGSTON DISTRICT

Salary: £965/£1,090 per annum under N.J.B. Class G, Grade 9, plus London weighting. Superannuable. Reclassification is probable from April, 1961. Consideration will be given to a car allowance and assistance with house purchase. Applicants should be suitably qualified and preferably hold the H.N.C. in electrical engineering or equivalent, and have had practical experience in general distribution work on systems up to 11 kV.

Applications quoting ET on forms from District Manager, Seeboard, 22 Claremont Rd, Surbiton, Surrey, by 1 March, 1961.

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ASSISTANT DISTRICT ENGINEER
GUILDFORD DISTRICT

Salary: £1,040/£1,165 under N.J.B. Class F, Grade 7. Superannuable. Preference given to applicants with technical qualifications up to H.N.C. standard and with practical experience of the planning, construction, operation and maintenance of MV and 11 kV underground and overhead systems. Consideration will be given to a private car allowance and assistance in house purchasing in appropriate circumstances. The successful applicant will be required to undertake standby duties. Applications, quoting ET, on forms from District Manager, Seeboard, Woodbridge Rd, Guildford, Surrey, by 1 March, 1961.

PRINCIPAL ASSISTANT (SECRETARIAL)
CROYDON AND WEST KENT SUB-AREA
HEADQUARTERS

Applicants should have experience in administration, preparation of reports and knowledge of the national negotiating machinery affecting the conditions of service and rates of pay in the Electricity Supply Industry. Salary: £1,380 x £40—£1,500 plus London allowance £50 under N.J.C. Grade 8. Applicants should preferably hold an appropriate qualification. Applications quoting ET and naming two referees to Croydon and West Kent Manager, Seeboard, Electric Hse, Wellesley Rd, Croydon, by 1 March, 1961.

GEORGE WRAY,
Secretary.
(T 627)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD
No. 4 Sub-Area
DEMONSTRATOR

REQUIRED in the Crewe District of the Board's No. 4 Sub-Area, based on Crewe. Salary within the range £600/£700 per annum (N.J.C. Grade 1).

Candidates should be over 21 years of age with demonstrating experience.

They should have a good knowledge of electrical appliances, and be competent to arrange and give public desmonstrations of cooking, laundering and housecraft subjects. The possession of a recognised Diploma in Domestic Science or other approved certificate desirable. The post is active and interesting, involving wide contact with the public, particularly women's organisations, schools and housewives.

Possession of a current driving licence would be an advantage.

Good holiday, sick pay and pension schemes. Appointment subject to medical examination.

Standard application forms obtainable from the Manager, No. 4 Sub-Area, Rhostyllen, nr. Wrexham, or from any District Office.

Closing date: 2 March, 1961. (T 595)

BRADFORD INSTITUTE OF TECHNOLOGY
Department of Electrical Engineering

APPLICATIONS are invited for the following posts in this rapidly expanding department which offers exceptional opportunities for teaching, consulting and research work:

SENIOR LECTURER IN ELECTRICAL ENGINEERING
SALARY SCALE: £1,550/£1,750.
LECTURER IN ELECTRICAL ENGINEERING
SALARY SCALE: £1,370/£1,550.

Candidates should be suitably qualified to teach to final degree standard in electrical power and machines **or** electronics and telecommunications. Industrial and research experience will be a recommendation.

The successful candidates will be encouraged to develop industrial contacts and undertake research for which adequate facilities will be available.

Previous industrial and research experience at a suitable level will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar (Department M), Bradford Institute of Technology, Bradford 7.

HENRY PATTEN,
Clerk to the Governors.
(T 630)

SOUTH WESTERN ELECTRICITY BOARD
ASSISTANT CHIEF COMMERCIAL OFFICER
(TARIFFS AND ECONOMICS)

APPLICATIONS are invited by the Board for the post of Assistant Chief Commercial Officer (Tariffs and Economics) on Grade A.7 of the National Joint Managerial and Higher Executive Grades Committee Scales within the salary range £2,170/£2,380 per annum.

Applicants should be broadly familiar with the economic factors affecting electricity supply costs and their relationship with the pricing policy of the industry.

Familiarity with load and cost research techniques is also desirable and particularly the ability to assimilate research data with a view to applying the results in a way which takes into account the practical possibilities of the situation.

The officer appointed will be responsible to the Chief Commercial Officer and, in addition to carrying out general economic studies and advising on the framing of all retail tariffs, will be responsible for drawing up special agreements and conducting negotiations with consumers from time to time.

Corporate Membership of the Institution of Electrical Engineers or the possession of an appropriate University Degree is very desirable.

Applications to be made on Standard Form AE6/ACT obtainable from the Establishments Officer, South Western Electricity Board, Electricity Hse, Colston Ave, Bristol 1. Closing date for receipt of completed applications is 4 March, 1961.
(T 635)

SOUTH WESTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following position:

FOURTH ASSISTANT DISTRICT ENGINEER
TORBAY—
LOCATED AT KINGSBRIDGE BRANCH

Salary according to Class G, Grade 11, Salary Scale 5, £825/£940 per annum, of the N.J.B. Agreement.

The duties of the successful applicant will be to assist in the supervision of maintenance work on the distribution network within the Kingsbridge Branch area and, when required, to supervise H.V. and L.V. construction works undertaken by the Branch organisation. The candidate appointed may be required to undertake standby duty.

Candidates should have had experience in the erection and maintenance of overhead and underground H.V. and L.V. networks and maintenance of substations. Possession of the Higher National Certificate in Electrical Engineering and the ability to drive a car will be an advantage.

Applications to be made on Standard Form AE6/ACT, OBTAINABLE BY POST-CARD ONLY from the District Manager, South Western Electricity Board, Electric Hse, Union St, Torquay. Closing date for receipt of completed applications is 4 March, 1961. (T 634)

CENTRAL ELECTRICITY GENERATING BOARD
ASSISTANT ELECTRICAL ENGINEER
(TECHNICAL SERVICES)

REQUIRED at the Research Laboratories, Leatherhead.

The successful applicant will assist in the supervision and organisation of the electrical installation and maintenance of 11 kV, 33 kV and 230/400 V distribution networks and the control gear and power wiring required in connection with experimental rigs.

Candidates, preferably with H.N.C. in Electrical Engineering or an equivalent qualification, should have first class experience of this type of work. A knowledge of the I.E.E. Rules and Regulations for Buildings is essential and it would be an advantage to have knowledge of the Distribution Safety Rules.

Salary within the range £955/£1,245 p.a.

Applications stating age, qualifications, experience, present position and salary, to the Appointments Officer, 24-30 Holborn, London E.C.1, as soon as possible. Envelopes should be marked "Confidential ET/58." (T 585)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Worcester and District Sub-Area

THIRD ASSISTANT ENGINEERS (TWO)
(PLANNING AND OPERATIONS SECTION)
(HEADQUARTERS)

The section is responsible for the planning and operation of 66 kV, 33 kV and 11 kV systems in a predominantly rural area. Experience of overhead systems and modern protective gear is essential. Technical qualifications will be an advantage. Salary: £1,115/£1,245 per annum (N.J.B. Grade K.10). Apply, by letter, within 14 days, stating age, qualifications, experience, present position and salary to Mr R. Mallet, Sub-Area Manager, Midlands Electricity Board, P.O. Box No. 52, Blackpole Rd, Worcester.

SECOND ASSISTANT DISTRICT ENGINEER
(KIDDERMINSTER)

Experience necessary in all branches of distribution work, including construction, maintenance and operation of high and low voltage underground and overhead systems and substations. Technical qualifications desirable. Salary: £1,040/£1,165 per annum (N.J.B. Grade F.7). Apply, by letter, within 14 days, stating age, experience, present position and salary, to District Manager, Midlands Electricity Board, New Rd, Kidderminster.

F. W. CATER,
Secretary.
(T 607)

YORKSHIRE ELECTRICITY BOARD

No. 7 (Grimsby) Sub-Area

SECOND ASSISTANT ENGINEER
(INDUSTRIAL DEVELOPMENT)

CANDIDATES should hold at least the Higher National Certificate in Electrical Engineering and will be required to advise consumers on the utilisation of electricity in industry. They should also have experience in negotiations for supply to industrial consumers. Experience of street lighting, industrial space heating and a knowledge of general tariff structures would be an added advantage.

Salary: N.J.B. Class K, Grade 7 (Scale 12), £1,350/£1,500 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Rd, Grimsby, not later than 3 March, 1961.

Head Office

THIRD ASSISTANT ENGINEER
DISTRIBUTION DESIGN (SUBSTATIONS)

Duties will include the design of indoor and outdoor substations operating at voltages of 33 kV and above, the preparation of specifications for substation plant and subsequent negotiations with plant manufacturers. They will also cover protective gear applications on the primary H.V. system.

Applications are invited from suitably qualified Engineers having a sound general knowledge of substation plant and some experience of field construction.

Salary: N.J.B. BX8 (Transitional to Scale 11) within the range £1,105/£1,410 per annum.

Applications, together with the names of two referees, should be sent to the Secretary, Yorkshire Electricity Board, Wetherby Rd, Scarcroft, nr. Leeds, not later than 3 March, 1961.

No. 3 (Sheffield) Sub-Area

ROTHERHAM AND MEXBOROUGH
DISTRICT

ASSISTANT INSTALLATION ENGINEER

Applicants should have served an apprenticeship and been technically trained in

continued in next column

continued from previous column

Electrical Contracting work. Experience in varied classes of electrical contracting work, including tendering, preparation of specifications and supervision of a large manual staff will be an advantage.

Salary: N.J.B. Class K, Grade 10 (Scale 9), £1,115/£1,245 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial St, Sheffield, not later than 3 March, 1961.

No. 6 (Hull) Sub-Area

HULL DISTRICT
FOURTH ASSISTANT DISTRICT ENGINEERS
(TWO POSTS)

Candidates should have had some experience subsequent to training in electrical engineering and should hold the Higher National Certificate in Electrical Engineering as a minimum qualification.

The successful candidates will be required to reside within the District and undertake standby duties.

Salary: N.J.B. Class K, Grade 11 (Scale 8), £1,040/£1,165 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 6 (Hull) Sub-Area, Yorkshire Electricity Board, Ferensway, Hull, not later than 3 March, 1961. (T 638)

SOUTHERN ELECTRICITY BOARD

GENERAL ASSISTANT ENGINEERS
(TWO VACANCIES)

CONSTRUCTION Department of No. 2 (Newbury) Sub-Area, located at Newbury (East Sub-Section) or Abingdon (North Sub-Section). Salary in each case N.J.B. Class M, Grade 18 (£715/£805 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the installation and erection of plant, equipment and overhead lines, the laying of cables and other construction work on all distribution systems up to and including 33 kV.

The successful applicant will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Secretary, 7 Oxford Rd, Newbury, and returned to him, quoting Z.1317, not later than 27 Feb., 1961. (T 637)

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

North Caledonia Area

APPLICATIONS are invited for the post of

THIRD ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE)

for duty with a maintenance squad at Fort Augustus, Inverness-shire. Experience in the construction and maintenance of overhead lines is required, and preferably tower lines. Technical qualifications an advantage. Salary and conditions in accordance with N.J.B. Schedule, Class H, Grade 9, £1,040 x £25—£1,165.

Application form obtainable from the Area Manager, West Villa, South St, Elgin, should be returned by 6 March, 1961, quoting Vacancy No. 61/2. (T 636)

EASTERN ELECTRICITY BOARD

Northmet Sub-Area

GENERAL ASSISTANT ENGINEERS
(ENGINEERING DRAUGHTSMEN)
MAINS DRAWING OFFICE (Ref. 1033)
21/61.R.

CANDIDATES should be experienced in the routine of a large Drawing Office and capable of recording underground mains and overhead lines and preparing plans and estimates.

CIVIL ENGINEERING AND BUILDING
OFFICE (Ref. 1034)
22/61.R.

Candidates should be capable of preparing plans, estimates and detailed drawings associated with Civil Engineering and Building Works.

Possession of an Ordinary National Certificate or equivalent qualification is desirable.

Salary for each of the above appointments: N.J.B. Class N, Grade 18, £765/£870 (plus £50 London Allowance).

The successful candidate will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Apply by letter to the Manager, Eastern Electricity Board, Northmet Sub-Area, Northmet Hse, Southgate, London N.14, by 27 Feb., 1961. (T 625)

Ferranti

Manchester

A vacancy has arisen in the Computer Department for an

ELECTRICAL ENGINEER

with good experience of Power Engineering.

Applicants should have H.N.C. (Elect.) and experience covering the installation of electrical equipment ranging from the initial planning to directing the work on customers' premises. A knowledge of electronics is not essential, but would be advantageous. The successful candidate will, in any event, be given a period of training after which he will be expected to work on his own initiative.

This is an excellent opportunity for a young Power Engineer who would like to participate in the new and rapidly expanding Computer Industry.

Forms of application can be obtained from T. J. Lunt, Staff Manager, Ferranti Ltd., Hollinwood, Lancs. Please quote reference CDS.

(T 589)

AIR MINISTRY
Works Designs Branch

REQUIRES in London and Provinces
ENGINEERING DESIGNER
DRAUGHTSMEN

experienced in preparation of schemes for illumination and electrical equipment of buildings or schemes for H.V. and M.V. electrical distribution. Candidates should have served recognised apprenticeship or had equiv. training and also have had practical exp. O.N.C. an advantage. Financial assistance and time off for recognised courses of study. Promotion and pension prospects. Five-day week with 18 days' paid leave per year initially. Overseas tours for which special allowances granted.

Salary: in London ranges from £805 (age 25) to £980 p.a., somewhat lower in Provinces. Commencing salary dependent on age, quals. and exp. Applicants, who must be natural born British subjects, should write quoting O/N King's Cross 4354 to Air Ministry, W.G.d, Theobalds Rd, London W.C.1, or to any Employment Exchange, giving age, details of training, quals., full particulars of former posts held and copies of any testimonials. Candidates selected will normally be interviewed in London and certain expenses reimbursed. (T 82)

FIJI
Post and Telegraphs Department
ENGINEER

DUTIES: to be responsible for organisation and execution of telecommunications work in Headquarters and districts and to initiate training of local staff.

Qualifications: Candidates (30-50 years) must be A.M.I.E.E. or possess a degree in Electrical Engineering and must have at least five years' experience in execution and maintenance of a telecommunications system with good working knowledge of modern telecommunication techniques including 12-channel and super-group carrier systems.

Terms of Appointment: Three-year contract. Salary in range £900/£1,809 according to experience and military service. Gratuity. Disturbance allowance. Free passages.

Write: Director of Recruitment, Colonial Office, London S.W.1, giving full names, age, qualifications and experience, quoting BCD 108/49/07/D10. (T 608)

PORT OF BRISTOL AUTHORITY
AN ASSISTANT ENGINEER (ELECTRICAL)

APPLICATIONS are invited for the above post, to be graded APT. IV, £1,140/£1,310. The appointed candidate will work under the direction of the Chief Assistant Engineer (Electrical), whose duties include the installation, operation and maintenance of electrical equipment and the specification and control of new works. Electricity consumption approximately 17,000 kW and 75 million units per annum.

2. Candidates should have served an approved apprenticeship and be Graduate or Associate Members of the Institution of Electrical Engineers.

3. The successful candidate will have to pass a medical examination before appointment. The position is pensionable under the provisions of the Local Government Superannuation Acts.

4. Applicants must disclose whether they are related to a member or senior officer of the Bristol Corporation. Canvassing disqualifies.

5. Applications, stating age, qualifications, experience, etc., and enclosing copies of any supporting documents, must reach me by 10 a.m. on 2 March, 1961.

T. L. MARTIN,
Engineer-in-Chief.

Port of Bristol Authority,
Avonmouth Docks,
Bristol. (T 529)

FOREMAN (ELECTRICAL)

required by

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

at Aldermaston, Berks.

to have responsibility for operation and maintenance work in connection with a static substation involving control room duties; generating plant and auxiliaries; H.V. and M.V. circuit-breakers, distribution, cable laying and jointing. The duties also include the care and testing of protective equipment and may involve shift working.

Applicants should have served a recognised engineering apprenticeship and have had previous experience on H.V. electrical generators and distribution. They should be familiar with the application of rules for safe working and be qualified as an authorised person. Possession of O.N.C. in Electrical Engineering or equivalent qualification is desirable.

SALARY: £1,015/£1,160 p.a.

A house or substantial assistance with house purchase will become available for married officers living beyond daily travelling distance.

Please write for application form to the Senior Recruitment Officer, A.W.R.E., Aldermaston, Berks, quoting reference 2866/49. (T 590)

Humphreys & Glasgow Ltd

ELECTRICAL ENGINEERS, A.M.I.E.E.

and

ELECTRICAL DESIGN DRAUGHTSMEN

are required in the Design Department of a world-wide organisation designing and constructing plant for

FUEL GAS PRODUCTION
CHEMICAL ENGINEERING PROCESSES
POWER STATIONS

Successful applicants would join a team of engineers engaged in all phases of work from design to commissioning of electrical installations associated with the above projects.

Salaries up to £1,600 for engineers and £1,300 for draughtsmen, according to qualifications and experience. Pension scheme, etc. Reply in writing to:

Chief Design Engineer,
Humphreys & Glasgow Ltd.,
22 Carlisle Place, London S.W.1.

(T 617)

BRITISH RAILWAYS
(Southern Region)

require a

TECHNICAL ASSISTANT
(INSPECTION)

in the Office of Mechanical and Electrical Engineer (Traction), London Bridge, for the inspection and testing of electric and diesel electric rolling stock and power supply equipment at Contractors' Works.

Applicants should have had a sound technical training. Manufacturing experience essential. Higher National Certificate in Electrical Engineering or equivalent desirable.

Commencing salary £1,070 per annum, rising to £1,145 after two years.

Application forms may be obtained from the Chief Mechanical and Electrical Engineer, British Railways, Southern Region (Staff Section), 15 St. Thomas St, London Bridge, S.E.1. (T 615)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

FIRST ASSISTANT DISTRICT ENGINEER

REQUIRED in the Liverpool North District of the Board's No. 1 Sub-Area. Salary within range £1,535/£1,720 per annum (N.J.B. J.4).

Applicants should have had experience in the construction, maintenance and operation of distribution networks up to and including 33 kV and be technically qualified.

Appointment subject to medical examination. Pension Scheme.

Special application forms, obtainable from the Manager, No. 1 Sub-Area, 24 Hatton Garden, Liverpool 3, should be returned not later than 6 March, 1961. (T 618)

THE EAST MIDLANDS ELECTRICITY BOARD
Ilkeston & North Derbyshire Sub-Area

Vacancy No. 20/61.
FOURTH ASSISTANT DISTRICT ENGINEER
CHESTERFIELD DISTRICT

SALARY: N.J.B. Class G, Grade 12, £765/£870 per annum.

The successful applicant will be required to assist in the planning of underground and overhead distribution systems, together with layouts of substations and the preparation of schemes on voltages up to 11 kV.

Applications should be forwarded to the Manager, Chesterfield District, Electricity Offices, 172 Chatsworth Rd, Chesterfield, within 14 days of the date of this advertisement. (T 632)

CENTRAL ELECTRICITY GENERATING BOARD
Eastern Division

APPLICATIONS are invited for the following appointments at Little Barford Generating Station (St. Neots, Hunts).
MAINTENANCE ENGINEER (ELECTRICAL)
(S.V. No. 1438)
MAINTENANCE ENGINEER (MECHANICAL)
(S.V. No. 1439)

Salaries: N.J.B., Class J, Grade 6, Scale 12, £1,350/£1,500 per annum.

Applicants should have had wide practical experience in electrical or mechanical maintenance at modern generating stations and should preferably be Corporate Members of the Institution of Electrical or Mechanical Engineers.

Housing accommodation will be available for the successful applicants.

Applications, quoting the appropriate reference S.V. No., stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts, by 25 Feb., 1961. (T 602)

RELIABLE CONTRACTOR

required

to service American cooking equipment. South West London Area at first. Other areas later if satisfactory.—**Box No. 8185, Electrical Times.** (T 598)

ELECTRICITY DEPARTMENT

APPLICATIONS are invited for the position of:
SENIOR TECHNICAL ASSISTANT
(ELECTRICAL)

Applicants, not more than 45 years of age, must have a University Degree or Higher National Certificate in Electrical Engineering, and preferably be Corporate Members of the Institution of Electrical Engineers. A sound engineering training and good practical experience of the operation and installation of electrical plant for large steam power stations and extra high voltage power distribution and transmission is essential.

Salary (in accordance with Scale No. 12, Grade 6, Class J, of the Northern Ireland Joint Board Schedule): £1,350 x £30—£1,500 per annum.

Superannuation contributions of approximately 6% of remuneration payable. Reciprocal pension arrangements exist between the Corporation and certain other Public Authorities.

Canvassing will disqualify.

Application forms may be obtained from Electricity Department, East Bridge St, Belfast 1. Completed applications must reach the undersigned by 10 March, 1961.

JOHN DUNLOP,
Town Clerk.

City Hall,
Belfast 1.
P.O. Box 234. (T 633)

HEAD WRIGHTSON
IRON & STEEL WORKS
ENGINEERING LIMITED

require

ELECTRICAL DRAUGHTSMEN

for the layout and design of industrial installations comprising power distribution, motor applications, lighting and allied design work. Experience of Iron and Steel Works practice an advantage but not essential.

Excellent working conditions with Pension and Life Assurance Scheme.

Apply stating age, qualifications and experience to:
The Personnel Manager, Ref. IS/39, Teesdale Iron Works, Thornaby-on-Tees. (T 597)

JUNIOR TECHNICAL SALES ENGINEERS

Required for Transformer Department to assist Senior Engineers in technical and commercial aspects of contracts with reference to power transformers and auxiliary control equipment. Suitable openings for young engineers aged 23-30 with appropriate practical and technical training who wish to gain or further their experience as Technical Sales Engineers.

Apply stating age, education, experience and present salary to Personnel Manager, Fuller Electric Ltd., Fulbourne Rd, E.17. (T 646)

SENIOR ESTIMATING ENGINEER

required for London Office of National Contractor, capable of preparing tenders and designing all types of commercial and industrial installations. Bonus scheme in operation in addition to salary. Apply in writing giving full details of qualifications, age, experience, etc., or telephone for an appointment. Duncan Watson (Electrical Engineers) Ltd., 60 Worship St, E.C.2. Telephone No.: BIS. 4752. (T 480)

SENIOR CONTRACTS ENGINEERS

required by National Contractors. Wide experience of all types of Electrical Installations essential. Bonus Scheme. Contributory Pension Scheme with Life Assurance. Write under private cover stating age, experience and salary required to Duncan Watson (Electrical Engineers) Ltd., Andrew Hse, 60 Worship St, London E.C.2. (T 576)

ELECTRICAL ENGINEERS
and
ENGINEERING DRAUGHTSMEN

required for interesting and rewarding work on engineering services in hospitals, including design work for new major construction.

SALARIES UP TO £1,600 FOR ENGINEERS AND UP TO £1,250 FOR DRAUGHTSMEN

Write now for further particulars to:
The Secretary (ref. 15/18)
BIRMINGHAM REGIONAL HOSPITAL BOARD
10 Augustus Rd, Edgbaston, Birmingham 15.
(T 591)

Unilever

ENGINEER

ASSISTANT ENGINEER

PRODUCTION MANAGER

CEYLONESE NATIONALS ARE REQUIRED TO FILL THESE VACANCIES IN LEVER BROTHERS FACTORY IN COLOMBO

Engineering candidates should have a recognised qualification and a knowledge of Mechanical and Electrical Engineering would be of advantage. Production candidates should possess qualifications in Chemistry or Chemical Engineering. All should be men of about 30 or below who are looking for a progressive management career in their own country.

The seniority in management of the appointments will depend on experience and qualifications; for those with good experience starting salaries are attractive with the addition of a rent assistance scheme, car allowance and four weeks' annual leave.

Successful candidates will receive a few months' experience of Unilever industries in the United Kingdom before proceeding to Ceylon.

Applications, giving full particulars of training and experience should be addressed to: Personnel Division (T/322), Unilever Hse, Blackfriars, London E.C.4.

(T 641)

PIRELLI-GENERAL CABLE WORKS LTD.

have vacancies for the following grades of staff:

ASSISTANT ENGINEERS

Assistant Engineers for supervision of cable contracts including oil-filled cable to the highest voltages. Applicants should have qualifications not less than O.N.C.

SITE CLERKS

For work in connection with invoicing, records and P.A.Y.E.

DRAUGHTSMEN

Draughtsmen qualified to carry out steelwork design for power station and industrial cable installations, also route record draughtsmen.

FOREMEN

Foremen with experience of power station and industrial installations, also of trenchwork and mains cable laying.

Applicants must be prepared to travel to work on contract sites or in Area Offices throughout Great Britain and willingness to travel abroad is also desirable.

An Outside Allowance will be paid when working on contract sites.

Application should be made to the **Manager, Installation Division, Pirelli-General Cable Works Ltd., Leigh Rd, Eastleigh.**

(T 592)

Training for Engineers
in the Electricity Supply Industry

The Electricity Supply Industry employs 18,000 electrical and mechanical engineers in all parts of England and Wales. They are responsible for generating electricity in the power stations, transmitting it over the Grid, and distributing it throughout the country. To keep this key force up to strength as older staff retire and sales of power rise, the industry needs each year to recruit several hundred young men to its technical training schemes.

Five-year apprenticeships are available to school-leavers who hold a good Ordinary level G.C.E., including maths. and a science, or two Advanced level passes in maths. and physics. Training is by means of planned practical experience, combined with day or "sandwich" release leading to an engineering qualification.

Two-year traineeships are offered to graduates holding a degree in electrical or mechanical engineering from a British university. Training provides extensive and varied practical experience and satisfies the requirement of the professional institutions.

Those who already possess an engineering Diploma may also be considered for practical training. This will be planned according to the previous experience of the trainee.

On satisfactory completion of training, all apprentices and trainees are guaranteed employment in this essential and expanding industry. A wide range of careers is available, in many types of engineering, including research and commercial development.

For further information write to:
The Education and Training Officer, The Electricity Council, 13 Winsley St., London, W.1.

(T 579)

ASSISTANT ELECTRICAL ENGINEER (25-35 years of age) required by electrical engineers and contractors in London W.C.2 district. Applicants must be experienced in estimating and control of installation contracts from inquiry to completion. Write giving details of experience, age and salary required to Box No. 8189, Electrical Times. (T 606)

DESIGN ENGINEER required for Consulting Engineers Office to undertake the design of electrical services for all classes of buildings, including hospitals, industrial and commercial buildings at home and abroad. Spring and Summer holidays. Pension Scheme and luncheon vouchers. Apply in writing stating age, experience, present salary and salary required to J. Roger Preston and Partners, 15 North Audley St, London W.1. (T 640)

ENGINEERING Consultants have vacancies for STUDENT APPRENTICES also JUNIOR ENGINEERS with experience in preparation of drawings and designs for electrical installations in all types of buildings. Apply in writing to Donald Smith, Seymour and Rooley, 113 Park St, London W.1. (T 582)

ELECTRICAL DRAUGHTSMAN experienced in schematic, panel layout and wiring and external wiring drawings for multi-motor control gear and automatic relay panels, required, following expansion.

Contributory Pension and Life Assurance Scheme in operation. Write (or 'phone: Eastleigh 2701) giving details of age and experience to Barron and Crowther Ltd., Woodside Rd, Eastleigh. (T 604)

ELECTRICAL ENGINEER required by Consulting Engineers, Piccadilly. Age about 30. H.N.C. and some years' experience of heavy equipment essential. Comm. salary and bonus about £1,100. Pensionable post. Write, with full details, to Box F346, c/o Streets, 110 Old Broad St, E.C.2. (T 639)

MARKETING MANAGER, excellent opportunity for keenness and enterprise; position is with a rapidly expanding Company wishing to enter the retail domestic equipment market. Applicants must be capable of initiating sales schemes and experienced in negotiating high level selling arrangements. Write to Sales Director, Rogerson Page Ltd., Lower Guildford Rd, Knaphill, Woking, Surrey. (T 584)

MANAGER required by Electrical Contractors experienced in comparable post handling diverse installation contracts on National scale for large Building projects. Thorough knowledge estimating, negotiations with architects and clients, able assume full responsibility for all technical and commercial aspects.

Good salary, Pension, Scheme, Company car and other attractive conditions to applicant of preferred age 42-50. Box No. 8193, Electrical Times. (T 619)

SENIOR and JUNIOR ELECTRICAL ENGINEERS required for London Consulting Engineer's office for installation design of industrial, commercial and educational buildings. Apply stating age, experience, training and salary required to Box No. 8183, Electrical Times. (T 588)

SUPERVISING ENGINEER (25 to 35) required by electrical contracting company in South. Experienced in planning and estimating, good terms for applicant with initiative.—Box No. 8187, Electrical Times. (T 605)

SALES MANAGER with good office, administrative and field experience. Knowledge of elec. o/h line systems. Age 35 or thereabouts. Salary in accordance with experience. Apply Bowthorpe Electric Co. Ltd., Crawley, Sussex. (T 573)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

TRANSFORMER DESIGNER preferably with some experience up to 20,000 kVA and 66 kV, required by well established Company in the South of England. Write with full particulars of experience, qualifications and salary required to Box No. 8181, Electrical Times. (T 587)

WELL ESTABLISHED Builders and Electrical Companies, London area, require top MANAGEMENT EXECUTIVE with ability to introduce new business. Excellent opportunities and good salary. Aged 35 to 47. Apply in writing, Box No. 8195, Electrical Times. (T 642)

AGENCIES

BRITISH Associates of Scandinavian manufacturers of decorative lighting fittings and shades, etc., are now open to receive applications from first-class agents in all areas, including London and the Home Counties.—Box No. 8177, Electrical Times. (T 554)

BRITISH SAROZAL LIMITED

who recently entered the air conditioning field, require AGENTS AND DISTRIBUTORS in several areas of England, Wales, Scotland and Ireland for their HYGRO-ROBOT packaged DEHUMIDIFIERS and a wide range of Measuring-Recording and Control Instruments for Humidity and Temperature. Inquiries are invited from firms of good standing with sales force and servicing facilities. B.S.L., 22 Berners St, London W.1. LANgham 9351. Quote ref.: ET. (T 599)

PATENTS

THE Proprietor of Patent No. 661972 for "Finger type Circuit Regulator and Contact Assembly therefor" desires to secure commercial exploitation by Licence or otherwise in the United Kingdom. Replies to Haseltine Lake and Co., 28 Southampton Bldgs, Chancery La, London W.C.2. (T 611)

TRADE ANNOUNCEMENT

ENFIELD-STANDARD POWER CABLES LIMITED

The Midlands Area Sales organisation of Enfield-Standard moved to:

FAZELEY STREET, BIRMINGHAM 5

ON MONDAY, 13 FEBRUARY.

Larger storage and warehouse facilities will provide even better service to all customers.

ENFIELD-STANDARD POWER CABLES LTD.
Fazeley Street, Birmingham 5.
Tel: VIC 5085

Head Office: Brimsdown, Enfield, Middx. Tel.: HOWard 2468.

(T 644)

FOR SALE

A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, Switchgear, Exhaust Fans, Hoists, Reduction Gears, new or reconditioned units.—CHI 5105, 67 Rothschild Rd, W.4. (T 3)

A.C. AND D.C. MOTORS, Generators, new and reconditioned. REWINDS and repairs promptly executed.—Service Electric Co. Ltd., Honeypot La, Stanmore, Middx. Edgware 5566. (T 224)

A.C. and D.C. SLOTMETERS: Time Switches and Quarterly Meters. Single and polyphase, 2½-100 amps. Tested and guaranteed 2 years. Television and Billiards Meters. — Tradex Meter Co., Surbiton. Elmbridge 2234/5/6. (T 9)

ELECTRIC MOTORS, D.C. and A.C. Motor Generator Sets, Alternators and Dynamos, Diesel Sets, Circuit-breakers, Switchboards, reconditioned and guaranteed. Very large stocks held.—Britannia Manufacturing Co. Ltd., Britannia Walk, N.1. CLErkenwell 5512/3/4. Stores at Chobham, Surrey. (T 7)

FLUORESCENT FITTINGS, Shells and Chokes to BS 2818 (Licence No. 3237) Coil Winding, all sheet metal work.—D. E. Cowling & Sons Ltd., Romside Trading Estate, North St, Romford 47282. (T 310)

HOUSE-SERVICE METERS, A.C. or D.C., quarterly or prepayment. — Universal Electrical, 221 City Rd, London E.C.1. (T 5)

HOUSE-SERVICE METERS, all types can be obtained by return from Selectrics, Dept. E.T., Meter Hse, Factory Row, Castle Circus, Torquay. Phone 7218. (T 8)

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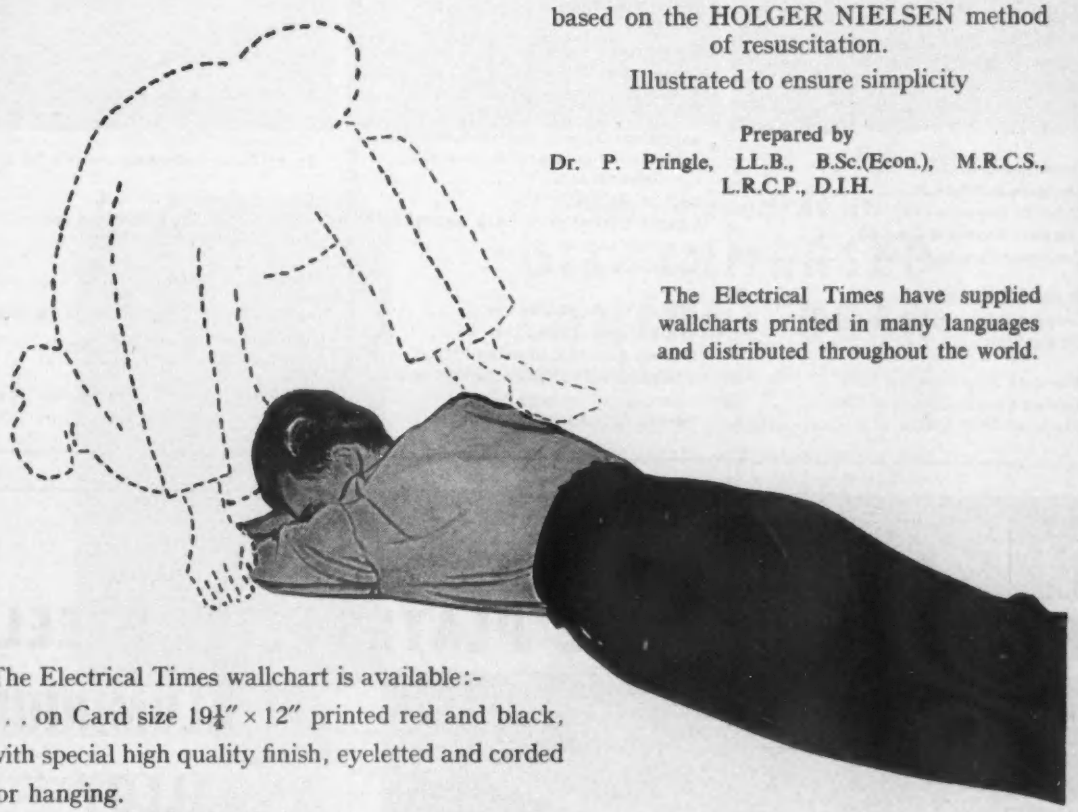

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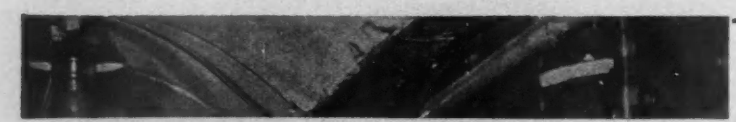

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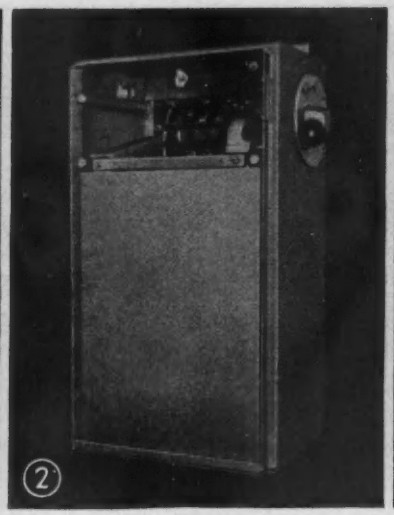

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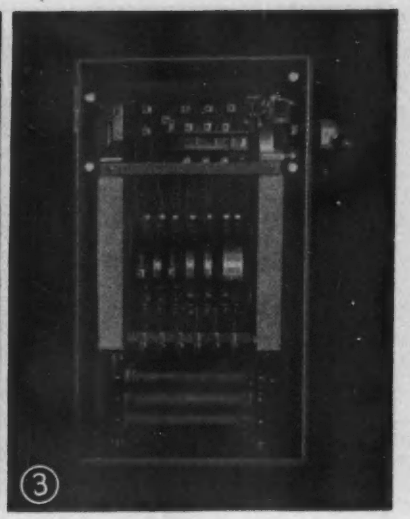

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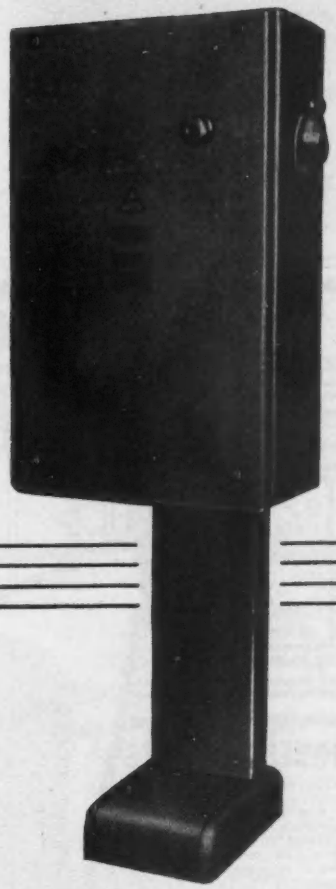

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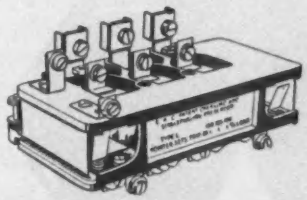

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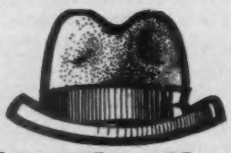

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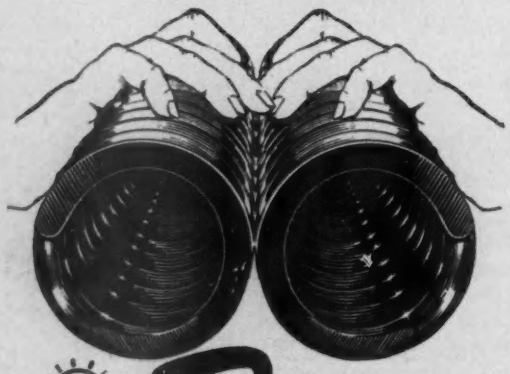

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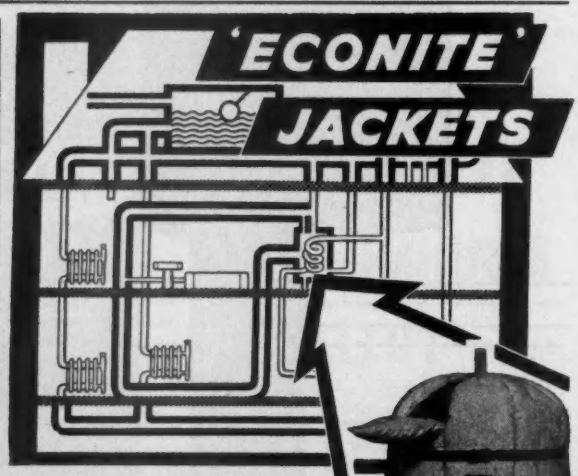

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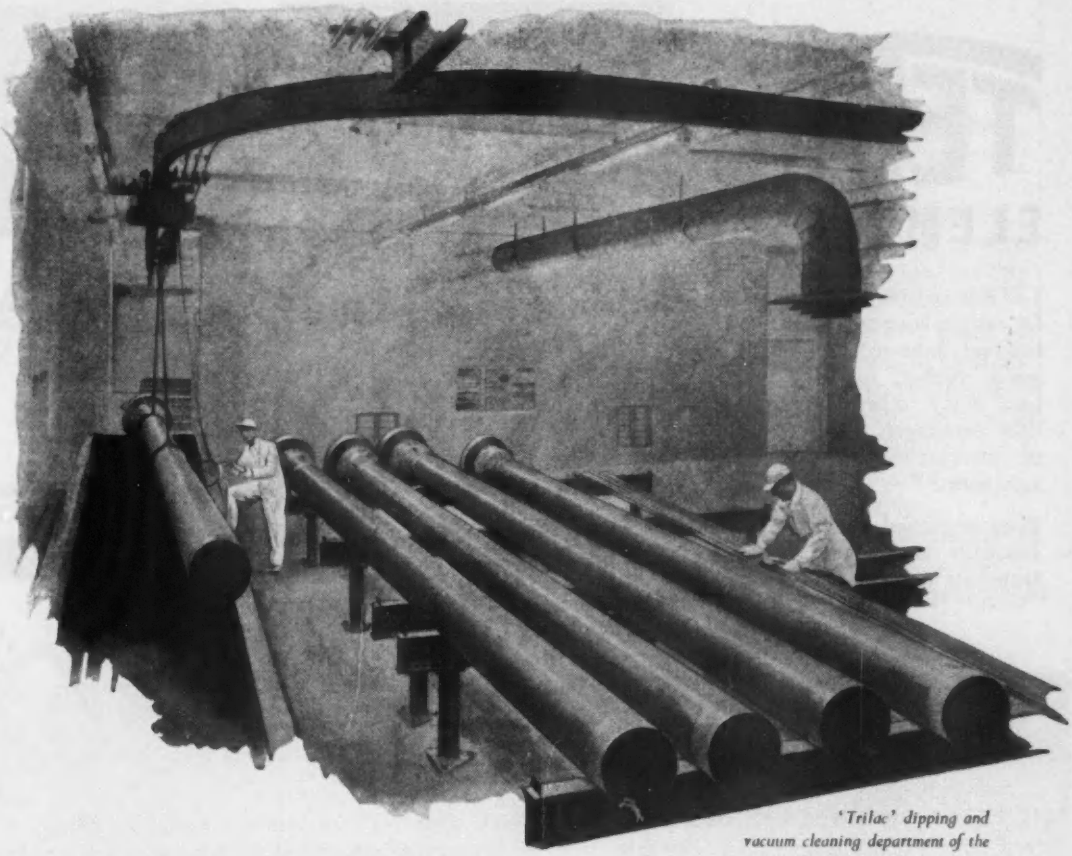

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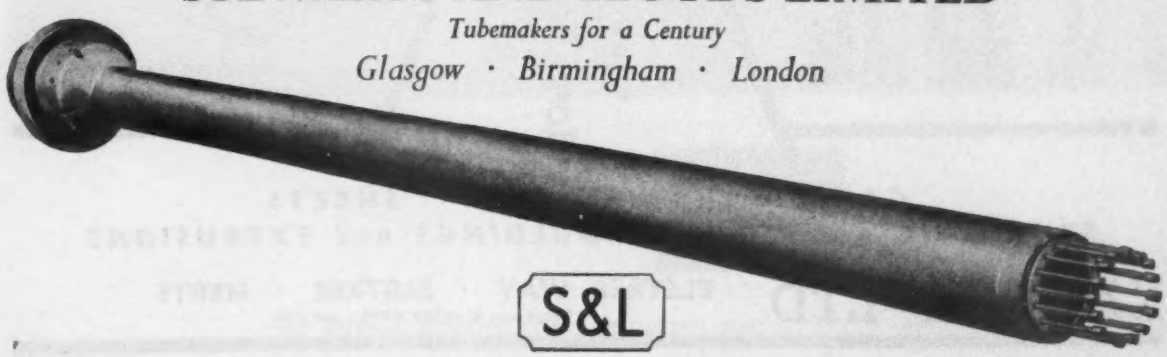

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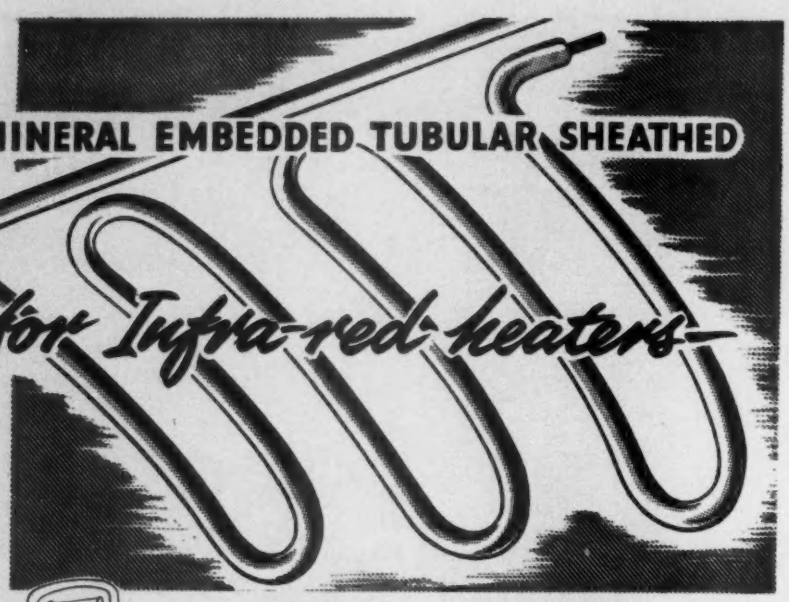

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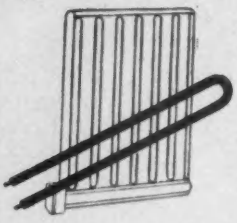

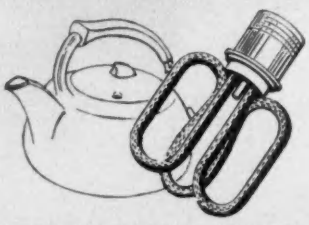

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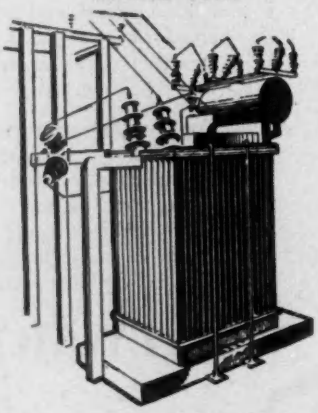

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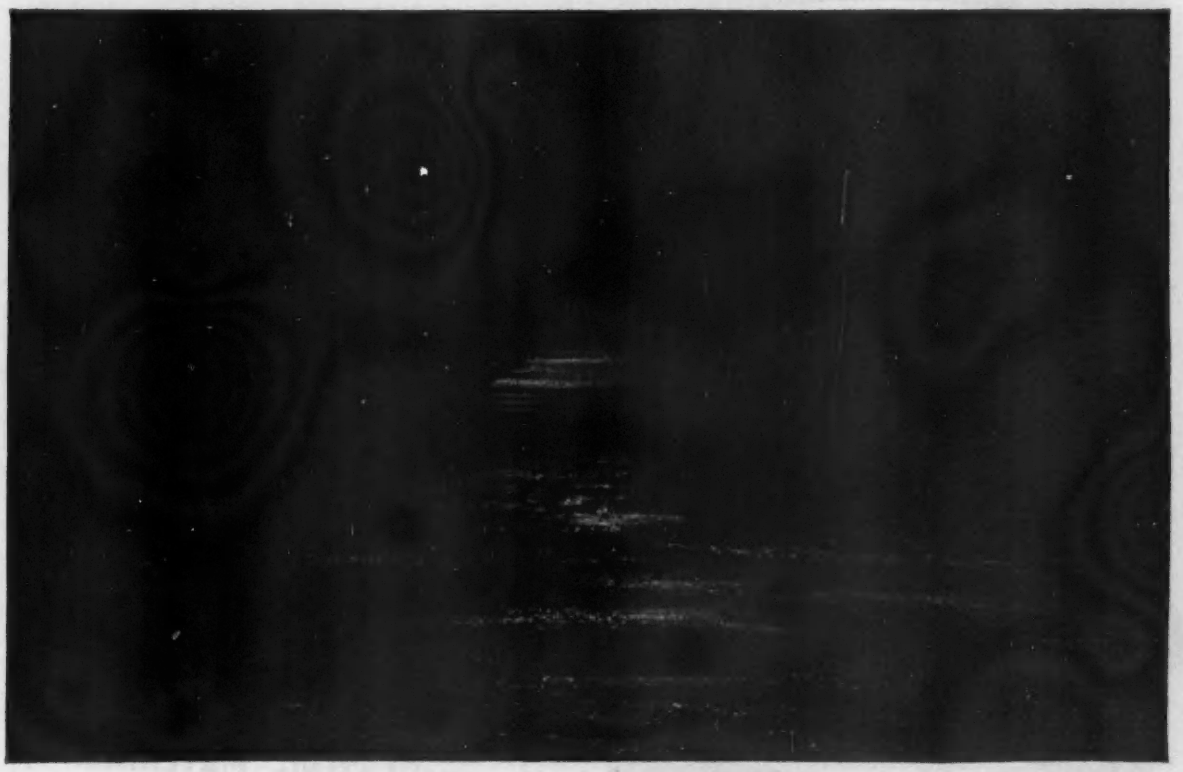

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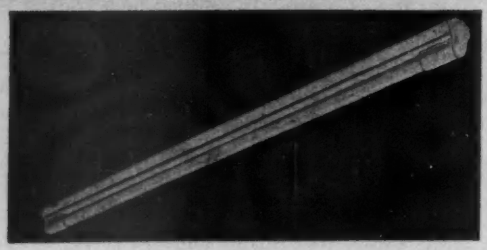

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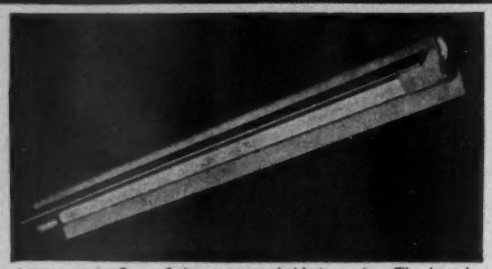

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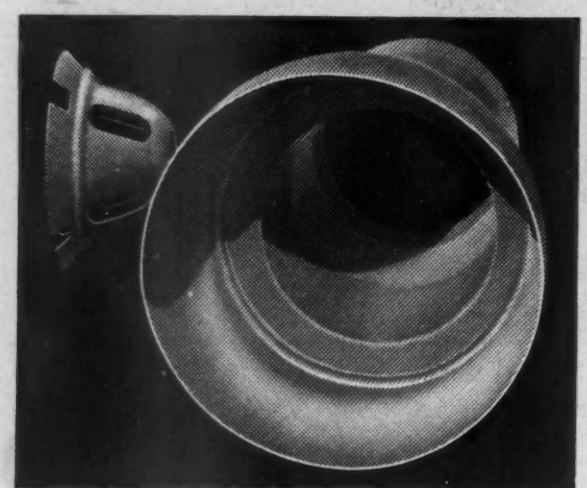

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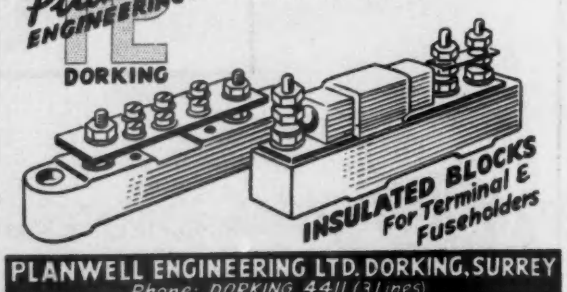

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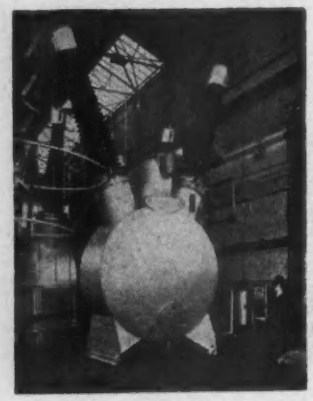

The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the AEI Ltd.

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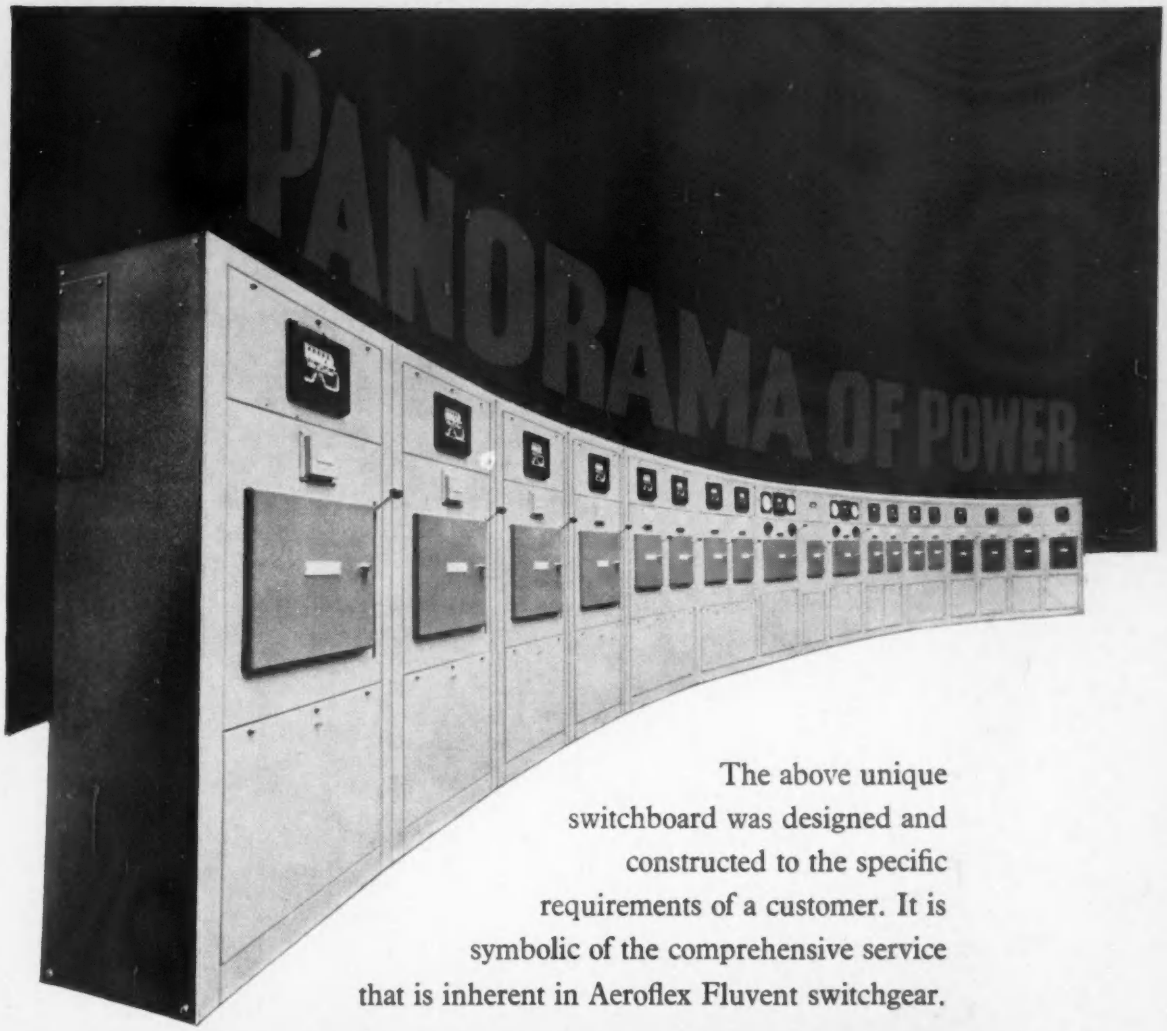

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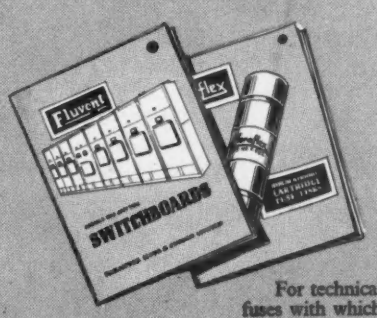

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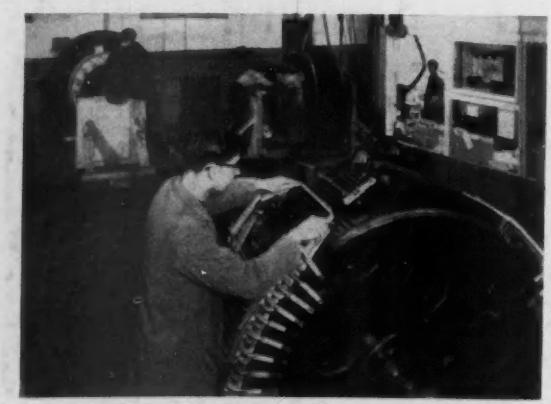

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